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ABSTRACT

The manual was intended primarily for use by lay instructors and assistants involved in the daily operation of school-community canneries under the supervision of a high school agricultural education instructor. The first half deals in detail with the fundamentals of food preparation and cannery operation. Food preservation by canning, sanitation in the canning structure, cannery equipment, and general canning procedures are discussed and illustrated. Detailed procedures for canning specific food products (in glass jars or cans) are presented for 34 food products in the general categories of fruit; vegetables; and meat, meat products, and poultry. Information on the yields of food products and the use of sugar in canning fruit is included. Three sample lesson plans for planning instruction in various areas of nutrition and food preservation are also in the manual. These plans offer teacher objectives, an introduction, group objectives, problems and concerns of students, references, suggested visual aids, special activities, and ideas for application and evaluation. A content summary provides basic information needed for each lesson. Appended is a list of sources of instructional materials on food preservation. A 28-item bibliography contains sources of additional information on food preservation. (MS)

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FOOD PRESERVATION MANUAL

A Guide for School-Community Canneries in Virginia

compiled and edited
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1975

Preface

The patronage of school-community canneries has been increasing in recent years. Many of these canneries were originally established in the 1930's, 40's, and 50's in Virginia. In the 1960's there was a decline in the use of these facilities. Beginning in the early 1970's there was a rather marked increase in usage. Much of this increase can be attributed to rising food prices and shortages of certain food items.

A definite need arose to make available the latest information on food preservation practices. The purposes of this document are to (1) review current standards for food preservation, (2) present details on the preservation of specific food products, and (3) present samples of lesson plans for teaching food preservation, including sources of instructional materials. In other words, this document is the result of an attempt to combine the technical aspects of food preservation with the educational functions of school-community canneries. To this end, joint planning and writing were conducted by food scientists and educators.

A primary consideration in the development of this document was the method in which school-community canneries are operated. In most cases, a high school agricultural education instructor has responsibility for the overall supervision of canneries. Home economics teachers are also involved, but to a lesser extent. The actual day-to-day operation of the canneries is often under the direction of a lay instructor and one or more assistants.

This document stresses the essentials of preservation as related to the proper processing of food. The terminology has been simplified so that a minimum of formal instruction is required in food science in order to read and understand the fundamentals of cannery operation and food preservation. A number of supplementary materials and references are listed. These should be of considerable help to cannery supervisors and instructors.

Acknowledgments

A number of persons have made substantial contributions to the evolution and development of this document. This is not the first document for food preservation and school-community cannery operation in Virginia. The work in preparing previous materials had considerable bearing on the content and format of this current edition. One of the persons making significant contributions in an earlier document was Claude E. Richard, formerly a Professor of Agricultural Education at Virginia Tech.

Many persons have been involved in the preparation of this publication. Charles B. Wood, Associate Professor of Food Science and Technology, is due considerable recognition for his work in preparing the content on the technical aspects of food preservation and cannery operation. Mr. Wood has many years of experience in the field of food preservation and has often consulted with personnel involved in the school-community canneries.

Other individuals who have provided considerable assistance are:

Mr. William C. Dudley, Assistant Supervisor of Agricultural Education, State Department of Education

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Jasper S. Lee
April 1975

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Part I

Fundamentals of Food Preservation and Cannery Operation

The purpose of Part I of this publication is to present a summary of the fundamental considerations in food preservation and cannery operation. Various illustrations have been used to clarify the manuscript, as needed. Major sections of Part I deal with the following topics:

Introduction to food preservation, specifically canning.
Sanitation in school-community canneries.
Inspection of cans and jars.
General procedures in canning.

Introduction to Food Preservation

The primary purpose of food preservation is the prevention of food spoilage. Some spoilage is manifested by comparative minor changes in the normal character of foods, such as slight alteration in odor, flavor and texture. Some types of spoilage manifest more extreme alterations, such as souring, molding and putrification. Most spoilage is caused by micro-organisms, such as yeasts, molds, and bacteria.

The yeasts, molds, and bacteria are very small organisms of the plant kingdom which utilize the same foods in their growth and development that are commonly used by man. These organisms are found in abundance in air, water, and soil. They undergo very rapid growth and development. Some bacteria may go through 100 generations in a twenty-four hour period or one generation in fifteen minutes. When lodged in or on foods, these spoilage organisms utilize the food to support the various phases of their life cycles. As a result, the natural characteristics of the foods are changed chemically, physically, or both, thus producing the condition commonly termed "food spoilage."

Like all living organisms, yeasts, molds, and bacteria can survive only under favorable conditions. If external conditions to which they are exposed become unfavorable, these spoilage organisms cannot grow or survive. Such conditions include extreme heat or cold, inadequate moisture, excess saltness and/or acidity of the food in which the organisms are present. The underlying principle of all food preservation methods is the creation of unfavorable environmental conditions--temporary or sustained--underwhich spoilage organisms cannot grow or survive.

Keeping these conditions in mind, it will be found that all preserved foods employ one or more of these principles. Dehydrated milk, salted herring, frozen orange juice, canned vegetables, and jams and jellies are a few examples of preserved foods employing some of the principles mentioned. Therefore, food may be preserved by chemicals, dehydration, and heat sterilization. For the purpose of this publication heat sterilization (canning) will be the principal method discussed.

Food Preservation by Canning

Canning can be defined as placing carefully selected and prepared food in a container that is hermetically sealed and then subjected to an elevated temperature for a time sufficient to destroy spoilage organisms and then cooled. Heating the contents of the container produces an unfavorable temperature condition for spoilage micro-organisms which may be present in the food; consequently, such organisms are destroyed or their growth inhibited. After cooling, the permanent seal of the container prevents recontamination of the product by spoilage organisms which are carried by air and water.

Figure I-1. Photograph of Greatly Enlarged Yeast Cells.

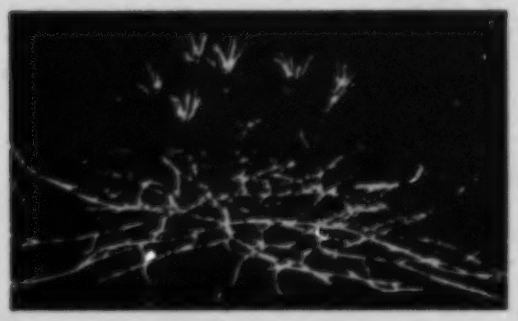


Figure I-2. Photograph of Greatly Enlarged Mold Showing Filaments and Spare Heads.

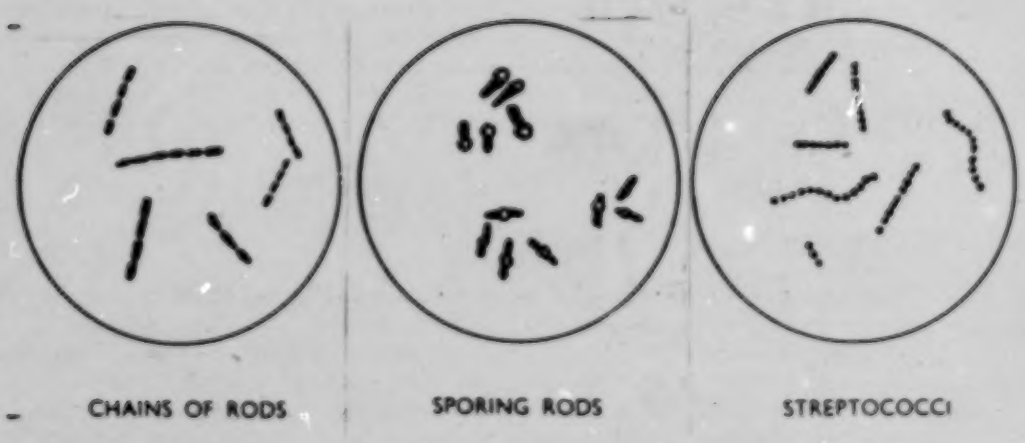
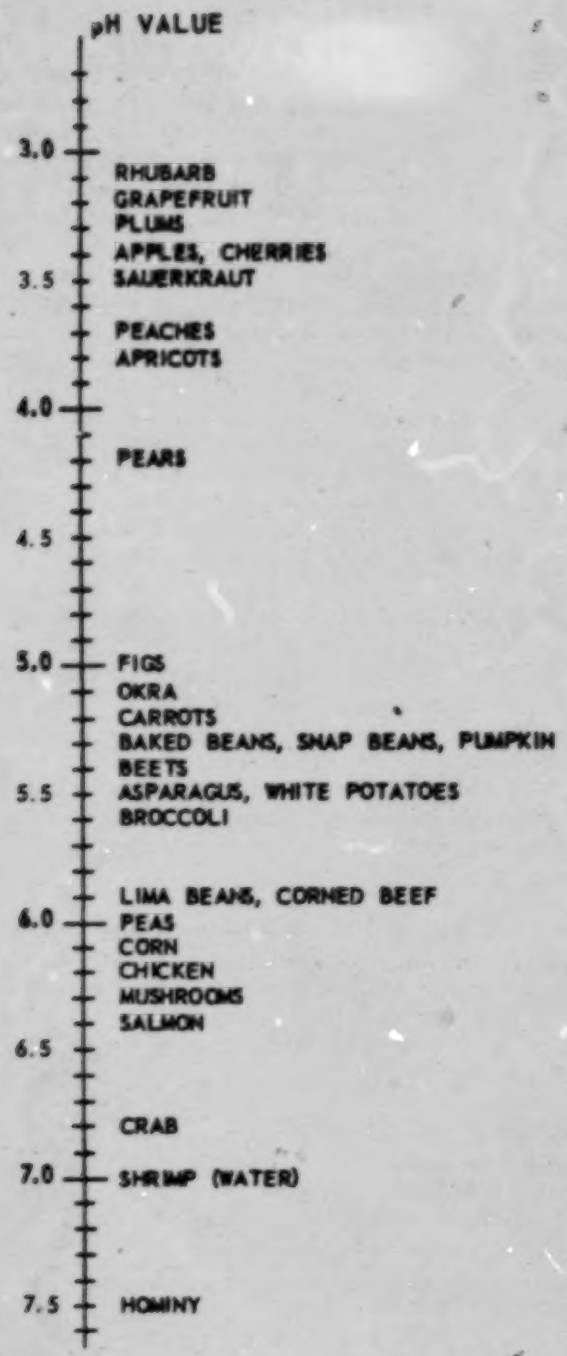


Figure I-3. Photograph of Greatly Enlarged Bacteria.



Representative pH Values of Different Foods
(Foods with low pH values are acidic and require less heat in processing.)

Selecting a method for commercially sterilizing a given can of food requires knowledge of (1) the type of micro-organisms that will probably be present in the food, (2) whether the food is an acid or low acid food, (3) the oil and fat content of the food, (4) the presence of starches or sugars, and (5) the size and shape of the container. Bacteria are the most resistant to heat of the three spoilage organisms. Yeasts exhibit the least resistance to heat while molds have only slightly more resistance than yeasts. Yeasts and molds will grow and develop in acid foods while bacteria are inhibited by the acid conditions. The combination of the acids in foods and heat during processing is most effective in destroying spoilage organisms. Therefore, the more acid a food has, the less heat required to destroy the organisms present.

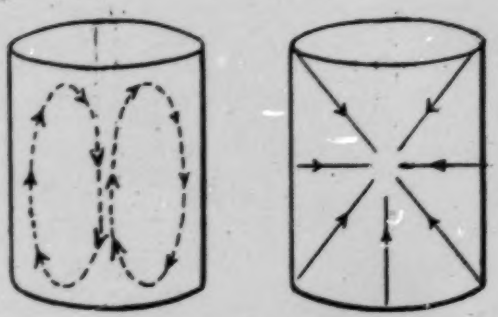
Acid foods can be safely processed in boiling water baths, 100°C. (212°F.). Most fruits and tomatoes are classified as high in acid. However, some of the new varieties, particularly new tomato varieties, contain less acid than the older varieties and, therefore, cannot be classified as acid foods. These varieties should be acidified with an approved organic food grade acid before processing.

Low-acid foods do not contain enough acid to destroy or inhibit the growth of bacteria without the application of high heat during processing. Processing under steam pressure is necessary to obtain temperatures sufficient to sterilize or process low-acid foods.

The heat resistance of an organism may differ, depending on the food in which it is heated. Products which contain oils and fats tend to protect the spoilage organism spores from heat by keeping them "dry," that is, free from external moisture, in which condition they are more difficult to destroy.

The addition of starches or sugars to foods increases the viscosity of the food; consequently, the rate that the heat penetrates the food to the coldest point in the container is slowed considerably. Foods to which either of these two ingredients has been added must be processed for a longer time than those foods to which no starches or sugars have been added.

The rate of speed at which heat penetrates to the coldest point in a container of food is an important factor in determining the length of time required for processing. This is because spore destruction involves both time and temperature. Heat moves from the walls of the container through the product, either by convection or conduction. With convection heating, there is an actual movement of the liquid in the container. Convection heating can only occur when there is a free liquid which can circulate.



Heat Penetration. (A illustrates convection heating and B illustrates conduction heating.)

The addition of starches or sugar to foods increases the viscosity of the free liquid, thus slowing down the movement of the liquid and retarding the rate of heat penetration. Foods containing fats and oils must also be given a longer process. Semi-solid or solid products, such as pumpkin, cream style corn, or baked beans, heat by conduction. Conduction involves transfer of heat from one food particle to the next. This is a slow method of heating, and processing times for such products are necessarily long.

Selecting the proper container in which the food is to be canned is most important. In most instances, glass is probably the most satisfactory container for all classes of foods. However, it does have some disadvantages, such as being fragile, requiring special techniques and time to process, and glass containers must be stored in dark places to prevent chemical changes from taking place in the food due to light. Metal containers (cans) are lighter weight, somewhat less fragile, and easier and quicker in processing than glass containers. Cans are made with several kinds of inside enamel linings or coating for different types of foods. Care should be given in selecting the proper can coating for the food to be canned. Metal containers also have certain disadvantages, such as, the necessity of exhausting to eliminate all air from the food and container before sealing and using special techniques in processing and cooling to prevent distortion of the container. Distortion could result in the container leaking, followed by spoilage. In sealing, it is necessary to frequently examine the closure seam to be sure that the seam is adequately strong and tight.

Foods are chemicals. Chemicals react more readily in warm temperatures than they do in temperatures just above freezing. Acid foods are more reactive than foods low in acid and, as a result, they are less stable and have a relative short storage life. Because low acid foods are more stable than acid foods, little change takes place in them when stored under proper conditions. Canned foods should be stored in as cool a place as possible that is above freezing to minimize chemical change.

Sanitation in the Canning Structure

Good sanitary conditions are important in food processing. This is true not only because of public health and good appearance, but also because sanitary practices contribute to better quality and keeping characteristics of canned foods. The cannery plant structure should be located in a low dust area with adjacent parking lot and roads either paved or treated to control dust. There should be good drainage away from the building to prevent water puddling which is a source of contamination to food products through seepage or foot-borne filth. Standing water also provides a breeding place for insects and micro-organisms. The building and the immediate vicinity surrounding it should be free from litter, waste, refuse, and uncut weeds and grass. These may constitute an attractant, breeding place, or harborage for rodents, insects, and other pests.

The building should be designed and constructed to facilitate maintenance and sanitary operation. The design of the building should provide sufficient space for placement of equipment and storage of materials as necessary for sanitary operation and production of safe food. Floors, walls and ceilings in the plant processing areas should be easily cleaned and kept in good repair. Fixtures, ducts and pipes that drip may contaminate foods and should not be suspended over working areas, raw materials or food contact surfaces. Aisles and working spaces between equipment and between equipment and walls should be unobstructed and wide enough to permit persons to perform their duties without contaminating foods or food-contact surfaces with clothing or other means. The building should have adequate lighting in hand-washing areas, toilet rooms, and all areas where food or food ingredients are examined, processed or stored and where equipment and utensils are cleaned. Adequate ventilation should be provided to minimize odors, noxious fumes, or vapors (including steam) in areas where they may contaminate food. The ventilating system should not create conditions that might contribute to food contamination by airborne contaminants. Effective screening or other protection against birds, insects and rodents should be provided.

All equipment and utensils should be suitable for the intended use. The design and construction of equipment should facilitate cleaning and maintenance. The water supply should be sufficient for the operation of the cannery and should be obtained from an adequate and safe source. Running water which is under pressure should be provided to all areas where food is processed and equipment and utensils are cleaned. Sewage should be disposed of adequately. Provisions should be made to trap solid waste and grease before reaching the disposal system. The plumbing system should be designed to do the following:

(1) carry sufficient quantities of water to required locations throughout the building;
(2) properly convey sewage and liquid disposal water from the building;
(3) not constitute a source of contamination to foods, food products or ingredients, water supply, equipment or utensils or create unsanitary conditions;
(4) provide adequate floor drainage in all areas where floors are subject to flood-type cleaning or where normal operations release or discharge water or liquid waste on the floor; and
(5) adequate toilet and associated hand washing facilities should be provided within the cannery building.

The facilities should be maintained in a sanitary condition and kept in good repair at all times. Doors to toilet rooms should be self-closing and should not open directly into areas where food is exposed to airborne contamination. Adequate and convenient facilities for washing

should be provided. No person affected by disease in a communicable form or while a carrier of such a disease, or while affected with boils, sores, infected wounds or other sources of microbiological contaminations, should work in a cannery plant in any capacity in which there is a reasonable possibility of food or food ingredients becoming contaminated by such person, or of disease being transmitted by such a person to other individuals. All persons, while working in direct contact with food preparation, food ingredients, or surfaces coming into contact with food should:

(1) wear clean outer clothing, maintain a high degree of personal cleanliness, and conform to hygenic practices while on duty to the extent necessary to prevent contamination of food products;

(2) wash their hands thoroughly in an adequate hand-washing facility before starting to work, after each absence from the work station and at any other time when the hands may have become soiled or contaminated; and

(3) not store clothing or other personal belongings, eat food or drink beverages, or use tobacco in any form in areas where food or food ingredients are exposed or in areas used for washing equipment or utensils.

Cannery Equipment

Care should be exercised in the selection of equipment for a canning operation. Frequently, equipment offered at bargain prices turns out not to be a bargain at all. Obsolete equipment, even if it is in excellent operating condition at the time of purchase, will often require greater maintenance. If such equipment should break down during the busy season and replacement parts cannot be obtained, it immediately becomes expensive. Every canning operation should initiate a preventive maintenance program in which all equipment is examined, repaired, and tested at least three months in advance of the date it is to be used. This will allow time to order parts for replacement and installation. Daily cleaning, greasing, and oiling must be performed on all pieces that require it during the operating season.

Boiler. The boiler is the heart of the canning plant. Therefore, it should be selected with great care, with consideration given to dependability and size. Boiler capacities are frequently listed in terms of boiler horsepower. With improved firing methods it was found that a boiler could develop more than "rated capacity." The most common description used today is the number of pounds of steam per hour that a boiler will produce under a specified set of conditions.

In estimating the steam requirements for a canning operation, one must take into consideration the peak demands of various operations with respect to the number and frequency of occurrence of these peak demands. These peaks will differ from operation demands and it is important that an adequate steam supply be available to preclude the possibility of affecting the efficiency of other operations which may be going on at the same time of peak demands. It is also important that the steam lines be adequate for the peak demands of the various operations

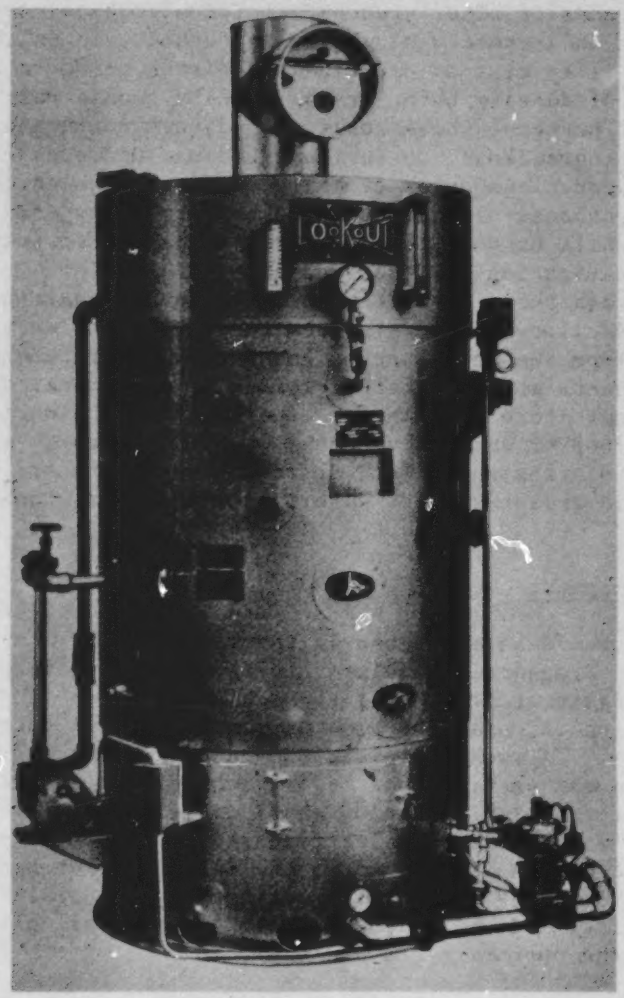


Figure I-4. A Modern Boiler for Use in a School-Community Cannery. (Photograph courtesy Lookout Boiler Corporation, Chattanooga, Tennessee.)

and installed in a manner to minimize condensation. The installation of steam traps where possible will help in reducing the demands on boilers since they allow for utilization of all the potential heat in the steam. For traps to be effective in reducing the demand on the boiler, it is important that they be properly sized to insure adequate condensate removal. The boiler should be installed in a separate room adjacent to the processing room where the retorts are located.

For good operating performance, water pressure should be in excess of 40 psi (pounds per square inch) and boiler steam pressure from 60 to 80 psi. Table 1 presents the steam requirements for most of the equipment used in a community cannery.

Table 1
Steam Requirements for Operating Canning Equipment
(Pounds Per Hour)

Equipment	Peak Demand (pounds)	Operating Demand (pounds)	Total Demand per Hr. (pounds)
Dixie No. 3 Retort (1.5 cycles / hr.)	80 (venting and come-up)	40	120
Dixie No. 3 Retort (as open cooker)		175	175
Dixie M-6 Blancher		70	70
Dixie M-2 Exhauster		345	345
10 Gal. Steam-Jacketed Kettle	20 (first 15 min.)	25	45
25 Gal. Steam-Jacketed Kettle	45 (first 15 min.)	85	130
40 Gal. Steam-Jacketed Kettle	70 (first 15 min.)	105	175
50 Gal. Steam-Jacketed Kettle	85 (first 15 min.)	140	225

Retort Equipment and Operation. A steam retort is a closed pressure vessel designed for processing low acid canned food under steam pressure at temperatures above boiling 100°C. (212°F). It can also be used as an open cooker for processing acid foods. The retort should be designed to process under pressure metal or glass containers and at atmospheric pressure.

The proper installation and operation of retorts is essential for the correct use of the processes given in this handbook. The following information provides a guide for the minimum requirements necessary for installing and operating retorts for pressure processing low acid foods.

(1) Steam Pressure. The steam pressure in the line to the retort should not be less than 70 psi at all times during the operation.

(2) Steam Header. The supply line delivering the steam to a group of retorts should be large enough to provide sufficient steam for the installed number of retorts that will be brought to retort temperature simultaneously. (A 1½-inch diameter steam header is usually large enough.)

(3) Steam Inlet. The steam inlet to each individual retort must be large enough (3/4 inch for Dixie No. 3) to provide sufficient steam for venting the retort in a reasonable length of time. It must enter the side near the bottom of the retort opposite the vent.

(4) Steam Controller. Each retort should be equipped with an automatic steam controller to accurately maintain the specified retort temperature within ± 1°C. (1°F.). This may be a self-actuated or air-actuated (air-to-open) type. It may be smaller than the steam inlet pipe if a by-pass is used during the coming-up time.

(5) Temperature Recorder. Each retort must be equipped with a temperature recorder, which is calibrated to agree with an accurate mercury-in-glass thermometer. The chart must be easily readable to 1°C. (1°F.) and the graduations should not exceed 2°C. (2°F.) within a range of 5°C. (10°F.) of the processing temperature. All charts should have a working scale of not less than 3 inches. The recorder may be combined with the steam controller and be a recording-controller instrument.

The sensing bulb may be installed within the retort shell below the steam spreader or in a thermometer well attached to the shell. A 1/8-inch or larger bleeder must be installed near the sensing bulb in the retort or well and left open at all times during the processing period.

(6) Steam Spreader. The steam spreader is a perforated continuation of the steam line inside the bottom of a retort in the form of a cross and is the same size as the steam inlet. The perforations should be on the sides of each length of pipe in the cross.

(7) Steam By-Pass. A steam by-pass for the control should be installed to make possible hand operation of the retort in the event of a failure of the control valve, and also to admit steam rapidly during venting and coming-up period when steam is usually demanded in larger quantities than the control valve is capable

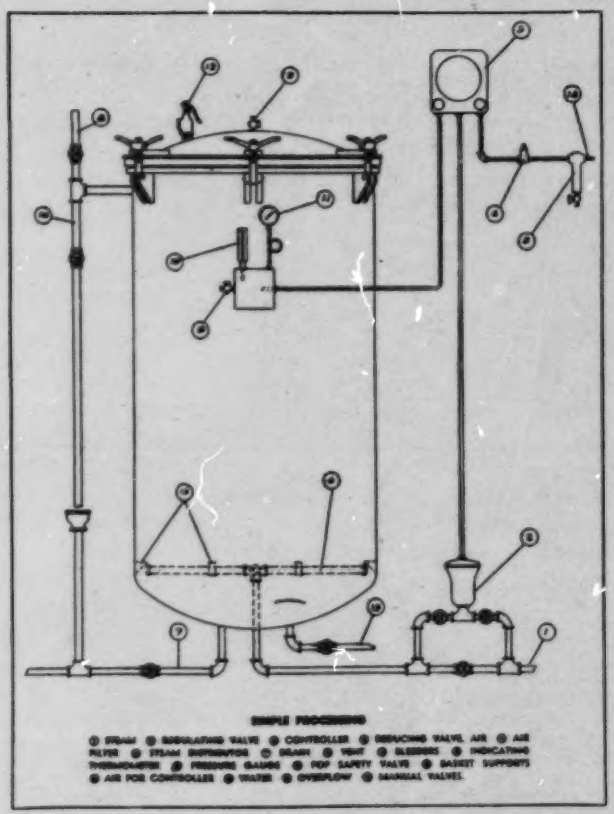


Figure I-5. Diagram Showing Parts of a Retort.

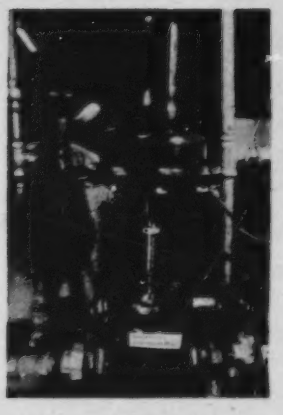


Figure I-6. Air-Actuated Temperature Regulator.

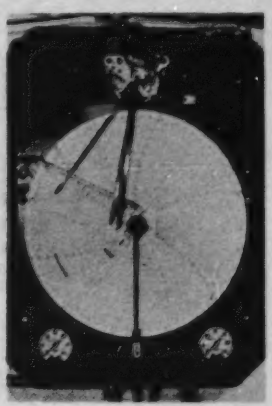


Figure I-7. Temperature Recorder.

of handling. This steam by-pass should be the same size as the steam inlet with an orifice of 3/8-inch in diameter for a Dixie No. 3 Retort.

(8) Safety Valve. A safety valve of adequate capacity is necessary to prevent excess pressure in a retort. The relieving capacity of the safety valve should be slightly in excess of the quantity of steam that will be emitted into the retort through the by-pass valve wide open.

(9) Vent. Vents are large valve-controlled openings in retorts, used for the elimination of air during the venting period. They should be installed in such a way that all the air can be removed from the retort before timing of the process is started. Vents must be controlled by a gate or quarter-turn quick opening-type valve which must be fully open to permit rapid discharge of air from the retort during the venting period. The vents and all external lines, manifolds, etc., should be short and as free as possible from bends and other conditions which might retard rapid discharge of air. Such lines should discharge to the atmosphere as close to the retort as possible. <u>They must not be connected directly to the drain</u>. If the overflow is used as a vent, there must be an atmospheric break in the line before it connects to the drain. This is required to prevent back pressure during venting and to meet plumbing codes. <u>The vent must be located in the extreme opposite side of the retort from that through which the steam is admitted</u>. During venting, the vent valve, steam valve, and steam by-pass valve are fully opened and the water and air valves are closed. The vent valve should be wide open for 5 minutes at 107°C. (225°F.).

(10) Water Line. The water inlet and supply line sizes and line pressure should be adequate to allow for rapid filling of the retort. Globe valves should be used on water lines. Water valves must be in good condition to insure that water does not enter the retort through a leaking valve, resulting in underprocessing.

(11) Air Line. A globe valve must be installed on the air line to avoid air leakage into the retort during processing, since steam-air mixture will reduce the effectiveness of the process and result in underprocessing. The air is used to cool down glass and large size cans (No. 2½--401 x 411--and larger) under pressure to prevent loss of liquid from jars and prevent "peaking" and "buckling" of large size cans.

(12) Indicating Mercury-in-Glass Thermometer. Each retort must be equipped with at least one mercury-in-glass thermometer having a range of not more than 55°C. (100°F.): 75° - 130°C. (170° - 270°F.) on a scale at least 7 inches in length. The scale divisions should be no more than 1°C. or 1°F.

Bulbs of indicating thermometers may be installed within the retort shell below the steam spreader or in an external well attached to the retort. The well must be connected to the retort through at least a 1-inch diameter opening, and be equipped with a 1/8-inch, or larger, bleeder so located as to provide a full flow of steam past the entire length of the thermometer bulb. The bleeder must emit steam continuously during the processing period. Should a thermometer be located in the lid of a retort, special care must be used in opening and closing the lid to prevent the mercury column from dividing. A thermometer with a divided mercury column must be replaced immediately. Thermometers should be tested for accuracy against a known accurate standard thermometer upon installation and at least once a year thereafter or anytime its accuracy is questioned. **THE MERCURY THERMOMETER, NOT THE PRESSURE GAGE OR THE RECORDER CHART, MUST BE THE OFFICIAL INSTRUMENT FOR INDICATING THE PROCESSING TEMPERATURE.**

(13) Pressure Gages. Each retort should be equipped with a pressure gage graduated in one pound divisions, with a range of 0 to 30 pounds. The minimum diameter of the dial should be 3½-inches, and the gage should preferably be of a type in which the operating mechanism is independent of the case. The gage should be connected to the retort by means of a siphon or a goose neck to protect the gage. Pressure gages should be tested against a known accurate standard gage upon installation and at least once a year thereafter or at anytime accuracy is questioned.

(14) Process Timing. A large, easily read clock or accurate timing device with an alarm should be installed where it can be observed readily by the retort operator. Processes should not be timed by the recording thermometer. Extreme care is required for process timing at retort temperatures. Even a process time slightly shorter than recommended will drastically lower the lethality of the process.

Figure I-8. Steam Spreader at Bottom of Retort.

Figure I-9. A Safety Valve.

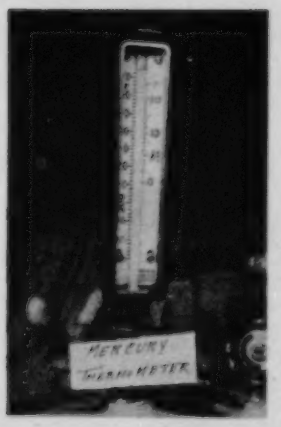


Figure I-10. A Mercury-in-Glass Thermometer.

Figure I-11. A Pressure Gauge.

(15) Bleeders. Bleeders are 1/8- to 1/4-inch petcocks used to remove any air entering the retort with the steam and to provide circulation of steam in the retort and past thermometer bulbs. One bleeder must be located at the end opposite to that at which steam is admitted. Bleeders are also necessary on all thermometer wells.

Bleeders MUST be open and emit steam continuously and freely during the entire process. Bleeders may be installed in the bottom of any retort to remove condensate.

(16) Drains. The drain should be large enough to permit the rapid removal of water after cooling. Only when the steam is admitted at the top should the drain be used as a vent. In this case, the drain line must be open to the atmosphere.

(17) Crates, Baskets, Trays, and Dividers. Containers used to hold cans in retorts should preferably be of strap iron. Perforated containers are satisfactory as long as there are sufficient perforations to allow steam to flow adequately among the cans. Insufficiently perforated crates, baskets, trays, or dividers should not be used since they lead to formation of low temperature areas in the crates or baskets.

Cans should be stacked so as to permit the free circulation of steam throughout the retort load. If it is necessary to separate two lots in one crate or basket, net or other material of 1/2-inch or larger mesh should be used. Do not use burlap sacks, boards, sugar sacks, towels, or other similar materials as dividers because they will interfere with steam circulation and cause underprocessing.

(18) Vacuum Break. A vacuum break-check valve, should be installed on retorts to prevent the retorts from collapsing during cooling when high negative pressure may be produced in rapid cooling with water.

Procedures in the Operation of Retorts

All cans should be closed and processed so that the ends will remain concave under normal storage conditions. To maintain concave ends, experience has indicated, the average temperature (temperature of the contents of can after thorough mixing) of each can at the time of closure should be at least 65°C. (150°F.). Cans of large diameter may require a much higher closing temperature to prevent distortion of the ends during processing.

Figure I-12. A Bleeder Valve.

Figure I-13. A Retort. (Courtesy Dixie Canner Equipment Company, Athens, Georgia.)

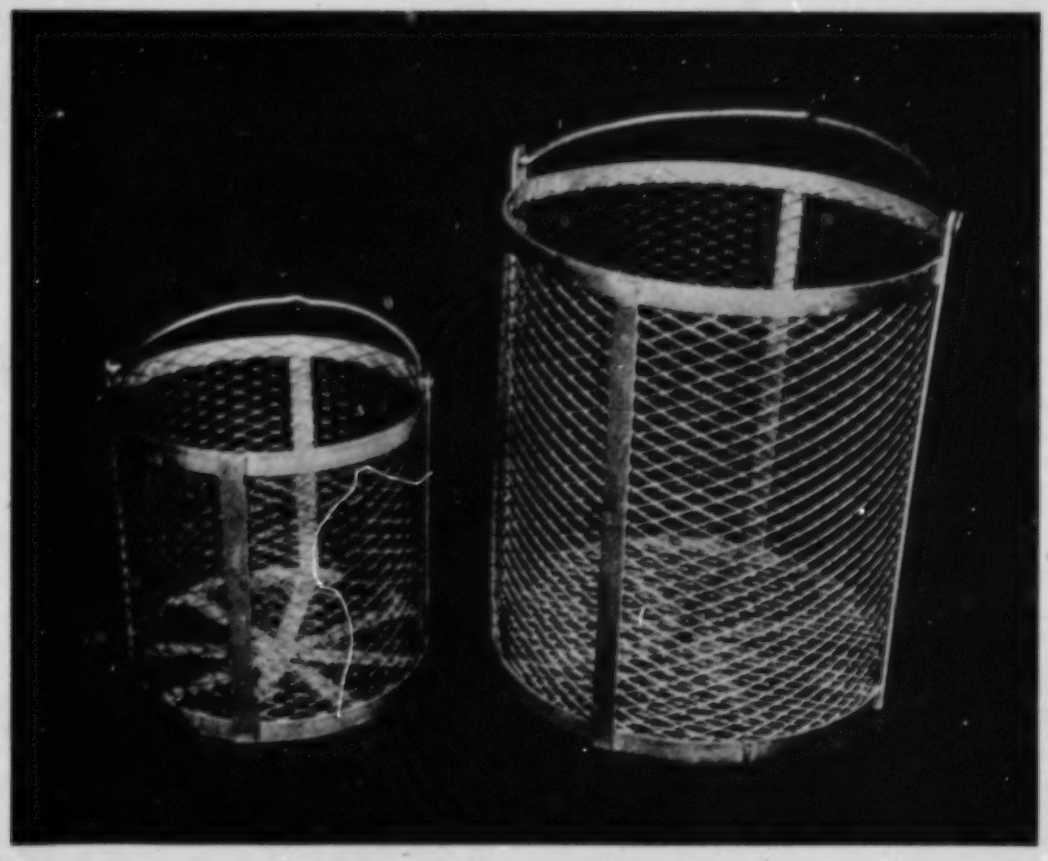


Figure I-14. Retort Crate Baskets. (Courtesy Dixie Canner Equipment Company, Athens, Georgia.

Coding. All containers should be coded to identify the patron, contents, and date.

Process. The term "process" as used in this handbook means the application of heat to sealed containers for a definite time and at a definite temperature under specific conditions. The purpose of processing is to produce a commercially sterile product. This must be obtained with the least possible adverse effect on quality. Commercial sterility for low-acid foods may be defined as that condition in which all Clostridium botulinum spores and all other pathogenic bacteria have been destroyed as well as more heat resistant organisms, which if present, could produce spoilage under normal storage conditions. If the number of organisms in the product is excessive, the processes listed might not be adequate to prevent spoilage. Therefore, it is essential that contamination be kept low.

Rapid Handling and Prompt Retorting of Filled Containers. A long holding period between closing and retorting may result in souring, off-flavor, and loss of vacuum. Depending upon the nature of the product, processing should follow within one-half to three-quarters of an hour after closure. If longer times are required to obtain enough containers to fill a retort, processing of partial retort loads should be practiced.

Position of Containers in Retort. Heat penetration in canned foods containing freely flowing liquids is mainly by convection currents. The general trend of these currents is in a vertical direction. Consequently, in the product being heated, the currents seek channels which permit such motion. Where progress is impeded or baffled by solid material, the currents flow around the obstruction to the nearest point at which they can pass. For this reason, the alignment of certain foods in the container is of the greatest importance in heat penetration.

Where the packing or filling of any product in the container results in stratification, the containers should be processed in such position that the plane of stratification is vertical. In the case of asparagus, for example, the spears are generally parallel and tightly packed in a vertical position. This means that the channels containing liquid are parallel to the spears. As a result, the speed of heat penetration is greater when the containers are placed upright in the retort. Another example is spinach. In large containers, the spinach is placed in more or less horizontal layers. Convection currents, therefore, travel to the center of the containers faster when the containers are processed on their sides rather than in a vertical position. Products such as peas and cut green beans consist of small solid bodies, fairly uniform in size and evenly distributed throughout a liquid medium; consequently, the rate of heat penetration is little affected or influenced by the position of the containers in the retort.

Cans or glass jars should not be placed directly on top of one another but should be staggered to allow for rapid and complete circulation of steam which will aid in eliminating air from the retort.

Solid or insufficient perforated metal retort crates should not be used because such equipment can lead to the formation of low-temperature regions. Sufficiently perforated dividers between layers of cans or jars facilitates stacking.

When processing glass jars in a retort, adjust the load in the crates so that when the lid is closed there will be a space of 6 or 8 inches between jar tops and the spray nozzles in the retort lid. This is necessary to assure even distribution of the water on the jars during cooling.

Starting a Process. At the time the steam is turned on, all bleeders and all valve-controlled vents should be wide open. All bleeders should be left open during the processing period.

(1) The valve-controlled vents should be left open for a sufficient time after steam is turned on to ensure that all air is swept out of the retort, so that no "pockets" of air remain among the containers. There is a tendency for steam to by-pass the load of containers and to escape through the vents before all air has been driven from the stacks of containers. An air-steam mixture in the retort will cause underprocessing.

(2) The timing of the process should not begin until the retort has been properly vented and the processing temperature has been reached. When the retort has reached the desired processing temperature, the temperature indicated on the mercury and recording thermometer should be checked. The pressure gage should not be relied on for an indication of the retort temperature. If the pressure gage is up but the temperature is low it means there is still air in the retort and venting should continue until agreement is reached. The chart must never indicate a temperature higher than the mercury thermometer. When the temperature is correct, start timing the process. Use an accurate clock for this purpose, not a wrist watch or the recorder chart.

(3) At the start of the process, enter on the production record the time, the mercury thermometer reading, the pressure, and the temperature indicated by the reading thermometer.

(4) Keep a record of the come-up time to make certain it has been long enough to allow for sufficient venting.

(5) Maintain the retort temperature about one degree above the recommended processing temperature. This helps to compensate for unavoidable fluctuations.

(6) As the process continues, check the temperature from time to time to make certain it is holding properly.

DAILY PRODUCTION RECORD

Cannery Location _____ Retort Operator _____ Date _____ 19___

Patron's No.	Temp. Chart No.	Retort No.	Cont. Size	No. of Cont.	Time in	Time up	Time out	Cook Min.	Mercury Thermo. Reading

Figure I-15. Sample Daily Production Record for Use in School-Community Canneries.

(7) Leave all bleeders open during the entire process.

(8) When the recommended time for the process has elapsed, turn off the steam and immediately start the cooling phase.

The quality of most products will be least affected by the process if the retort is brought up to processing temperature quickly and the process is followed by prompt and rapid cooling. This procedure not only protects the quality of the product but also shortens the total time required for each processing cycle.

Cooling. Cooling is accomplished in several ways: (1) with a water tank or under water spray, (2) pressure cooling with steam and water, and (3) pressure cooling with air and water.

Cooling with a water tank or under water spray is used for No. 2 or smaller cans. This is used following the "blow-down" method of releasing pressure, and for larger containers, that have been partly cooled under pressure, as follows:

(1) Open the overflow, drain or vent valve and permit the pressure to discharge until all the pressure is out of the retort.

(2) Open the top water valve slowly and spray the cans with water for about a minute to remove some of the heat. Make certain that water is not admitted before the vent is open and the pressure has been down to zero for a short time, or a vacuum may be created as the water condenses the steam, causing the cans to buckle and, perhaps, the retort to collapse. A vacuum-break check-valve will also prevent a vacuum from being formed. Most insurance companies now require a vacuum-break on all retorts.

(3) Remove the basket of containers from the retort and transfer it to the cooling tank or under water spray.

With the method of cooling with steam and water, steam is admitted to the top of the retort and is used to maintain the pressure. It is prevented from condensing in the cooling water by admitting the cold water under a layer of hot water in the bottom of the retort. The layer of hot water may be obtained by connecting a steam line to the bottom water inlet and heating the water as it is added for the first few minutes of the cooling. Proceed with the cooling as follows:

(1) When the process is completed, close all the bleeders, turn off the bottom steam inlet, open the top steam inlet and raise the pressure in the retort about 2 pounds above that used during the process.

(2) Open the steam line connected to the bottom water inlet and gradually open the water valve, thus running hot water into the retort.

(3) Continue to admit steam with the water until the retort is approximately one-fourth full. Then turn off the steam and add cold water under the layer of hot water.

(4) Maintain a constant pressure by gradually turning off the top steam valve as the retort fills with water.

(5) Maintain the pressure at that used for processing, or slightly above, until the retort is nearly full of water and the containers are covered.

(6) It is advisable to install a petcock near the top of the retort to indicate when the water has reached that level. When the water nears the top, open the overflow, vent or drain valve slightly and begin to close the water inlet to maintain the pressure at the desired point. If the retort is allowed to completely fill with water under full pressure without relief, the pressure in the retort may jump rapidly to the pressure in the water line. This might result in collapse of the containers and damage to the retort.

(7) Maintain the desired pressure in the retort by a proper balance of water inlet and overflow opening.

(8) Continue opening the overflow or drain to release the pressure gradually.

(9) Cool with water entering at the bottom and leaving through the overflow for a few minutes, and then reverse the flow by using water in at the top and out through the drain. However, keep the retort full of water. This reversal of flow results in a uniform cool.

Pressure cooling with air and water is used with glass mason-type jars and large metal containers. The procedure is as follows:

(1) When the process has been completed, close all bleeders.

(2) Admit air to the retort and increase the pressure about 2 pounds above that used during the process.

(3) Turn off the steam.

(4) Gradually admit water through the spray nozzels in top of retort, holding the pressure by means of compressed air.

(5) Using a petcock which has been installed near the top of the retort to indicate when water has reached that level, open the overflow or drain valve slightly, close the air valve, and begin to close the water

inlet to maintain the pressure at the desired point. If the retort is allowed to completely fill with water under full line pressure without relief, the pressure in the retort may jump rapidly to the pressure in the water line. This might result in collapse of containers and damage to the retort.

(6) Maintain the desired pressure in the retort by a proper balance of water inlet and overflow opening.

(7) Continue cooling by running water in at the top and out through the drain. This direction of water flow gives uniform cooling if the water supply is sufficient.

(8) Maintain the pressure at that used for processing for several minutes. Do not allow it to fluctuate.

Amount of Cooling Necessary. The amount and extent of cooling will depend on the product and the methods of handling containers after cooling. In general, containers should be cooled to an average temperature of 38° - 41°C. (100° - 105°F.). This leaves enough heat to dry the containers quickly but not enough to permit the growth of thermophiles, if the containers are cased immediately. If the containers are stored in cases at temperatures above 41°C. (105°F.), stack burning may result as well as thermophilic spoilage.

Production Record. A daily production record should be kept, with separate data for each retort load. Making recordings of the beginning and end of the process, the time, and the thermometer, recorder, and pressure gage readings.

Atmospheric Cooker

The atmospheric cooker functions as a steam bath at atmospheric pressure. Steam enters at the top forcing the air downward and out through a water seal. Actually, it operates at approximately 0.05 pounds positive pressure due to head of water forming the water seal. Savings in steam over water bath is substantial. During the process only a limited amount of steam escapes from the cooker. The cooker is loaded and unloaded when the steam is off.

Operating Procedure. The following procedures are used in operating an atmospheric cooker:

(1) Open steam valve and blow out the condensate in steam line before placing the cover over glass jars, as the condensate may break the jars.

(2) Fill base with water and place the loaded insert crate on support in base pan. Then lower the cover into place over the insert crate with bottom of cover centered on projecting legs of crate support.

(3) Open steam valve slowly for first minute, then continue opening valve until steam bubbles freely through water seal in base pan. When thermometer registers 100°C. (212°F.), throttle steam so that only a small amount escapes through the water seal. Check the mercury thermometer to see that it maintains 100°C. (212°F.) throughout the processing period. Start the processing time when the thermometer reaches 100°C. (212°F.) and process for the length of time recommended in the table. After the processing time is completed, turn off steam valve, raise cooker cover and remove the loaded insert crate and transfer it to external cooling spray in cooling vat.

Cooling. The following procedure is used in cooling glass containers with the atmospheric cooler:

(1) Open valve No. 1 (small fine spray) for about a minute and open valve No. 5 (large spray).

(2) Leave both sprays open until products have cooled to approximately 38°C. (100°F.).

The procedure for cooling metal containers is:

(1) Place metal containers either under the spray or in a vat of cooling water.

(2) Cool as rapidly as possible to approximately 38°C. (100°F.). This leaves enough heat in the containers to dry them and prevent rusting.

Steam Exhaust Box

A steam exhaust box is essentially a close fitting steam chest into which the open can of product may be placed or through which the filled container may be conveyed. The exhaust box is used for heating the contents of the container to remove air from the filled container, thus establishing conditions whereby the finished canned product will show a substantial degree of vacuum. A properly exhausted hermetical sealed container will be able to withstand the internal pressure that is produced during processing without damaging the seams or seal of the container. It is not necessary to exhaust glass jars with the two piece lids because air and gasses escape during processing.

A batch-type exhaust box employing hot water heated by steam passing through closed pipes in the box is economical in the use of steam and adaptable to handling varied products. A batch-type box should be large enough to exhaust enough containers at one time to fill a retort. If not, several boxes may be needed. A float-valve installed on the water inlet pipe will maintain the level of water within 1½ inches of the top of the open containers in the box.

A continuous steam exhaust box is constructed so that the containers are conveyed between two perforated steam pipes admitting steam very close to the containers. The tunnel in a steam exhaust box is approximately twelve feet long. Normally, the exhaust line, or box, conveys the containers directly from the filling to the closing operations. The speed of the conveyor is regulated to allow the containers to be in contact with the steam sufficient time to raise the temperature of the contents to the desired closing temperature.

Steam Blancher - Cooler

The steam blancher - cooler consists of a chamber in which the product is placed in trays two to three inches deep and exposed to a steam atmosphere for several minutes. The length of time of exposure depends on the product. The tray is then pushed from the blanching chamber to the cooling area where a very fine water mist is allowed to spray onto the product until its temperature is lowered sufficiently for either canning or freezing. Steam blanching is preferred over hot water blanching because the loss of water soluble vitamins and minerals is not as great.

Sinks and Preparation Surfaces

Sinks and preparation surfaces should be designed and constructed of material that will be easy to clean and maintain. The preferred material is stainless steel. All inside corners should be cove in design to permit easy cleaning. The number and size of sinks and preparation surfaces should be sufficient to handle the volume of patrons and to utilize the facilities to the fullest potential without crowding. Overcrowding could create situations where the probability of the food being contaminated is increased.

Corn Cutters

The change in corn, resulting in loss of flavor, sugar and texture, starts as soon as the ears of corn are pulled from the stalk. To obtain a high quality processed product of fine flavor, it is necessary to process corn as soon after harvesting as possible. This cannot be accomplished as effectively if preparation for canning or freezing is done by hand. Cutting corn from the cob by hand slows down preparation of this product to such a degree that quality of the finished product may be adversely affected.

A corn cutter machine will remove corn, which is whole grain, from the cob at the rate of 20 to 25 ears per minute. This reduces preparation time sufficiently so that the full flavor of fresh pulled corn may be maintained in canning.

Figure I-16. A Continuous Steam Exhaust Line. (Courtesy Dixie Canner Equipment Company, Athens, Georgia.)

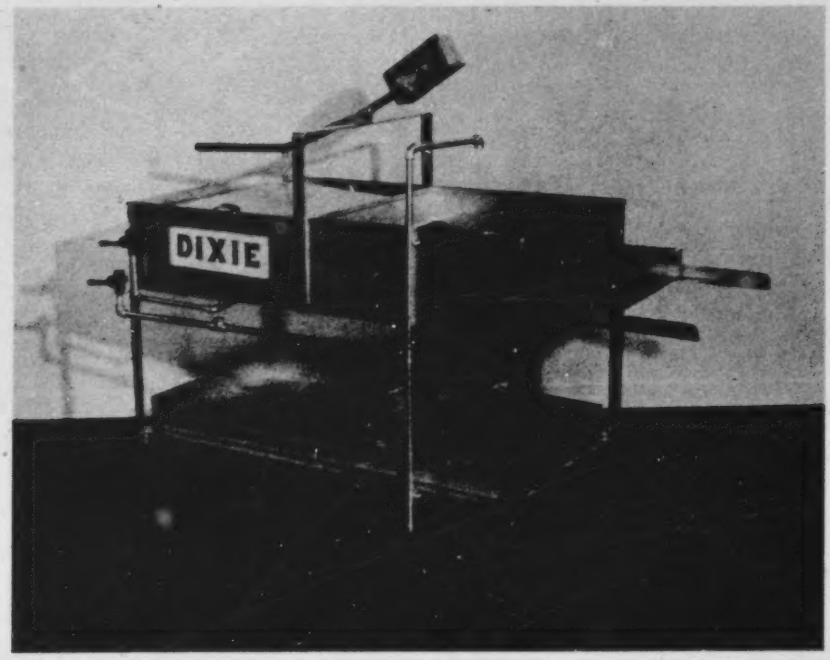


Figure I-17. A Blancher-Scalder-Washer. (Courtesy Dixie Canner Equipment Company, Athens, Georgia.)

Can Sealers

The number and size of can sealers needed are determined by the anticipated daily output of the cannery and the sizes of cans that are to be used. A motor-driven, bench-type semi-automatic can sealer is capable of sealing five or six cans per minute. At least three sealers of this type should be provided for canneries having a capacity of 1500 to 2500 cans per day. Canning centers processing food in No. 10--603 x 700--cans will require a larger size sealer for this size can.

Can sealers should be located on a sturdy table adjacent to the hot water exhaust box or mounted on the table of a continuous steam exhaust tunnel so that the containers can be sealed immediately after being exhausted before they have a chance to cool. The sealing of the can is the operation that safeguards its contents. The success of the entire canning project depends on this function.

Operating Principle of Sealers. A can sealer is a machine designed to form the double seam which attaches the cover to the can in such a manner as to effect a hermetic closure. While models vary widely in design, speed of operation, and a number of other details, they all have in common the following units essential in forming and rolling a double seam.

(1) Chuck. The chuck is machined to fit snugly into the recessed cover or countersink of the can. It serves the dual purpose of steadying the can and acting as an anvil against which the seam is formed. In some machines, the chuck is slightly knurled for traction which enables it to rotate the can.

(2) Seaming Rolls. The seaming rolls are divided into two classes according to their purposes. The "first-operation roll" has a groove which is semicircular and serves the purpose of turning the edge of the cover over the top flange of the can. This puts the cover hook and the body hook, as they are known, in proper position for sealing.

The "second-operation roll" is very similar to the first in that it bears the same relationship to the chuck, and that it is activated by the same force that is automatically controlled. Its purpose is to smooth down or flatten the loosely formed layers of tin plate of the rounded seam made by the first-operation roll. For this purpose the seaming groove in the second-operation roll has a shallower and flatter groove contour than the first-operation roll.

(3) Base Plate. The base plate is a base or platform on which the can is supported during the seaming operation. In most machines it is free running and has no effect on driving the can. The purpose of the base

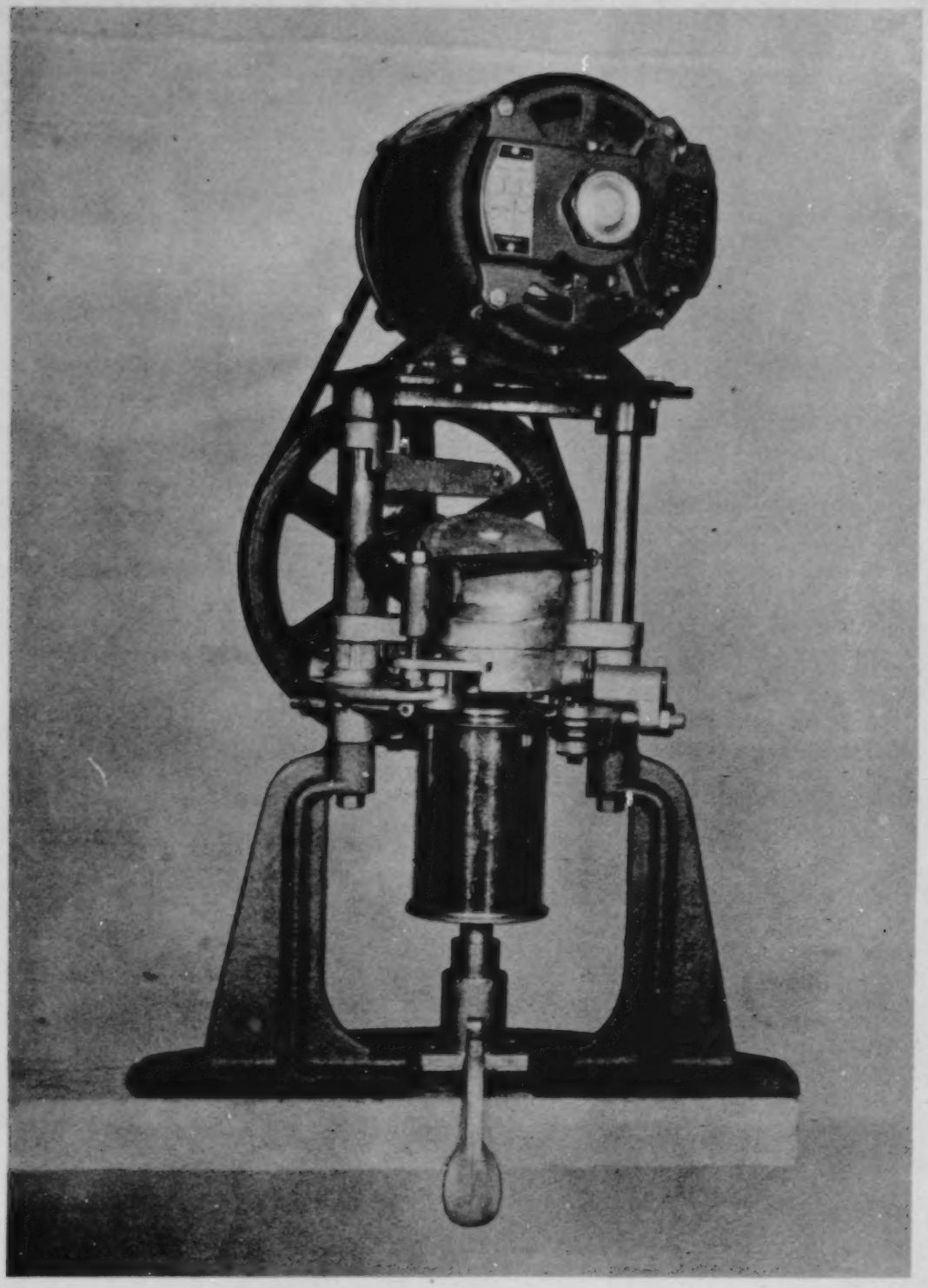
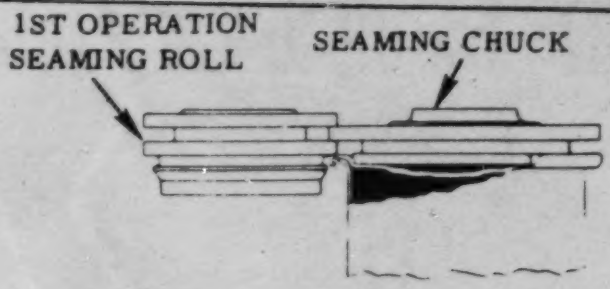
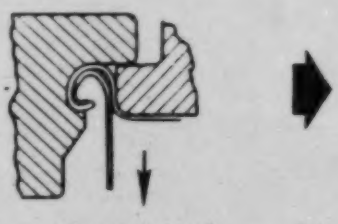
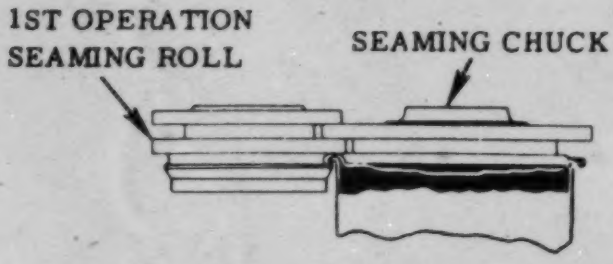


Figure I-18. A Can Sealer. (Courtesy Dixie Canner Equipment Company, Athens, Georgia.)



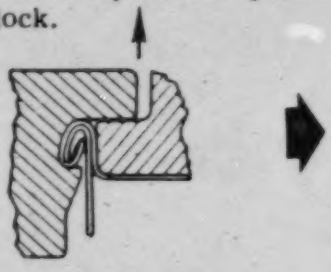
1 BEFORE SEAMING

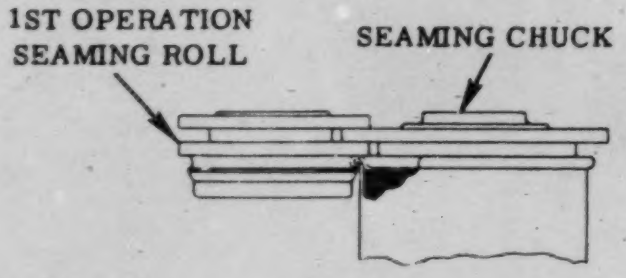




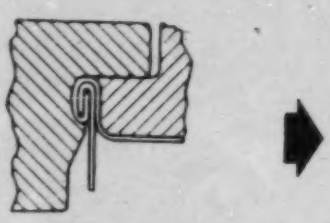
2 AFTER START OF 1ST OPERATION SEAM

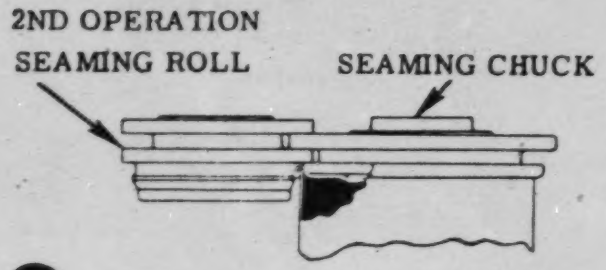
Double seaming is performed in two operations. The first operation roll curls the end hook around the inside of the body hook to provide an interlock.





3 FINISHED 1ST OPERATION





The 2nd operation roll tightens the seam and flattens the metal.

4 FINISHED DOUBLE SEAM

SEQUENCE OF OPERATIONS–SEAMING A CAN END ONTO A CAN BODY

plate is to give the can the proper pressure of distance between the bottom of the can and the chuck. This is to ensure the correct body hook length and to provide a rotating base. The rotating base should be oiled frequently.

Each of these parts is so machined that it can be adjusted to assure a perfect seam.

Double Seam Inspection

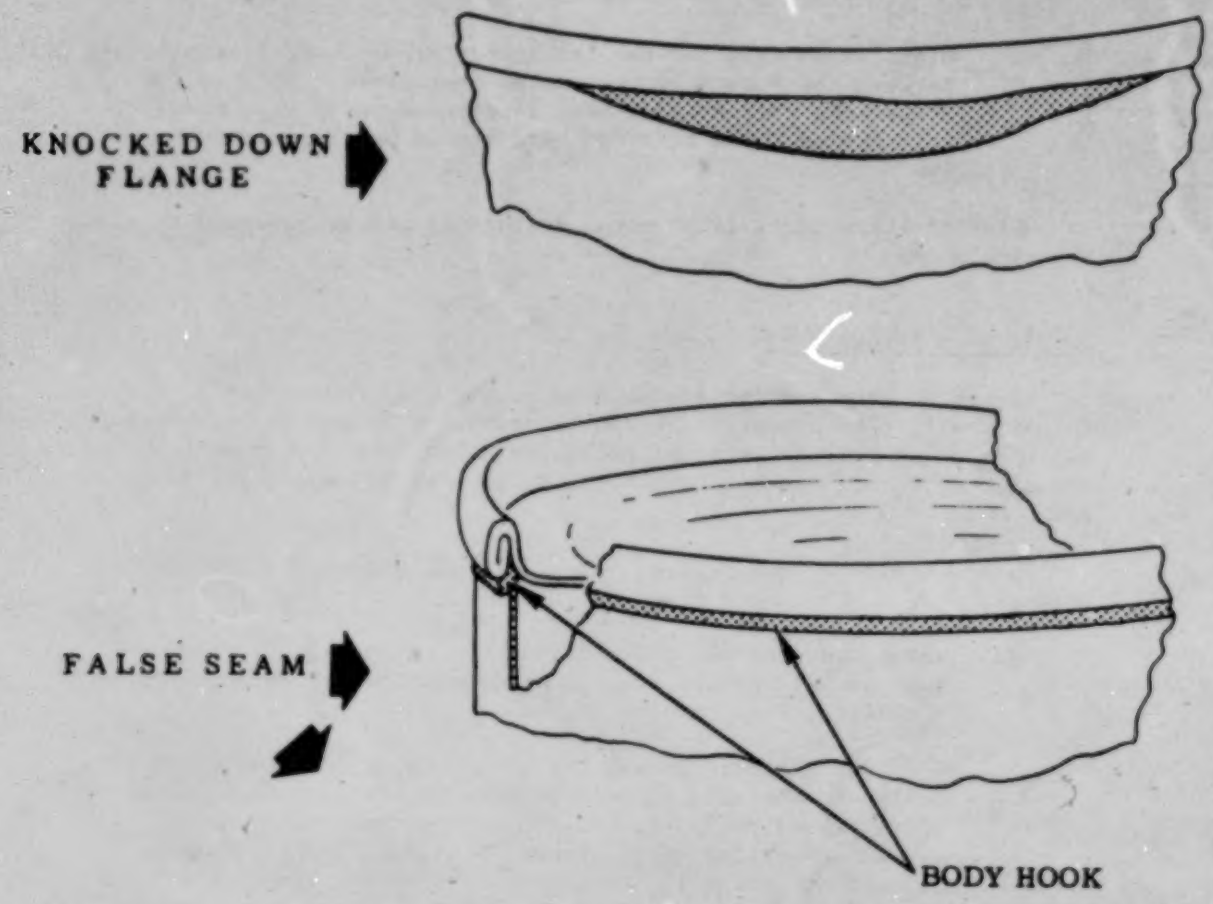
Seams of cans must be adequate to retain the product within the container. With some products the double seam must be permanently resistant to internal as well as external pressures. The double seam must be rugged enough to withstand normal conditions of processing, handling, and storage.

When examining double seams, the following procedures are most important:

(1) Visual Inspection. Visual inspection consists of using the hand as well as the eye. Some defects can be detected more readily by feel than by sight.

Run a finger around the seam both on the inside (chuck wall) and the outside to determine if any roughness, unevenness, or sharpness exists. This, together with careful visual inspection, will determine if any of the following defects are present: deadheads (incomplete seam), knock down flange, excessive droop, broken chuck, false seam, jumpover or excessive scuffing in the chuck wall area.

(2) External Seam Measurements. All seam measurements are to be made at three points of the seam:
(a) Approximately ½ inch left of the side seam.
(b) Approximately ½ inch right of the side seam.
(c) Approximately on the opposite side of the can from the side seam.
A micrometer, especially made to facilitate measuring double seams is used. To measure the seam width, hold the flat surface of the micrometer against the can body. When taking the thickness measurement of the seam, the micrometer should be balanced with the index finger immediately above the seam until the anvil of the micrometer assumes the same angle as the taper of the countersink. This instrument is also suitable for measuring overall lengths of Body Hooks. Care should be exercised that the micrometer is in proper adjustment at all times.



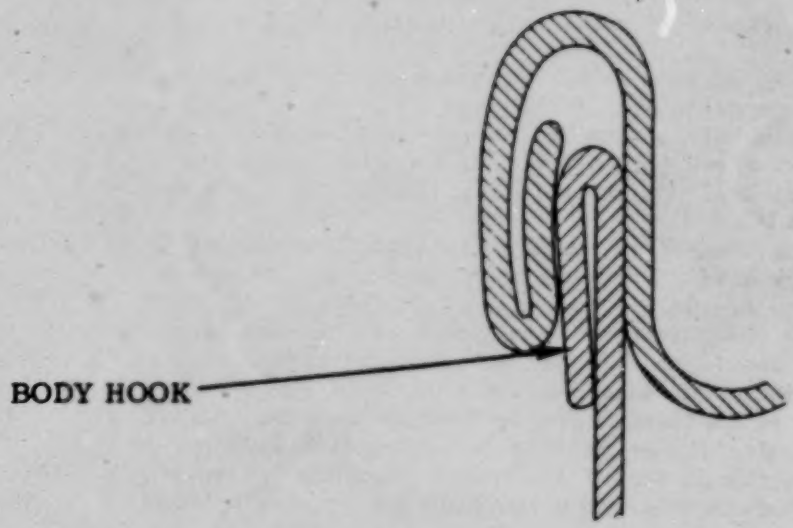
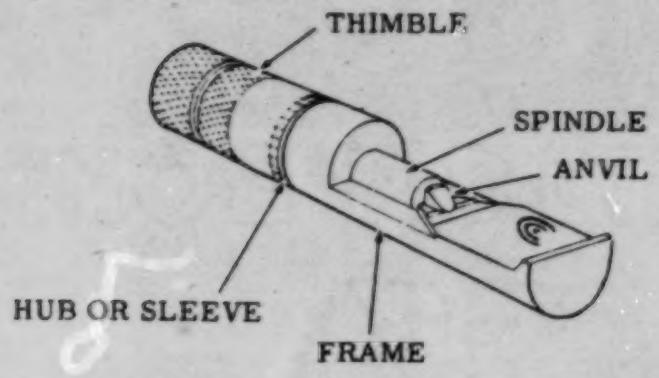


ILLUSTRATION OF EXTERNALLY VISIBLE DOUBLE SEAMING DEFECTS

When the micrometer is set at zero position, the zero graduation on the moveable barrel should match exactly with the index line on the stationery member. If for any reason the zero graduation is more than one-half a space from the index line at this setting, and adjustment should be made.



END SEAM MICROMETER GAUGE

(3) Internal Seam Measurements. Expose the body and cover hooks for measurement and inspection by separating the body and cover hook of the finished seam. Measure the cover hook, beginning at least ½ inch to the right of the side seam. Measurements should be taken at three equal locations around the perimeter of the can by using the seam micrometer. For most sizes of cans, the minimum length of cover hook should not be less than 0.070 inch and the maximum length should not exceed 0.090 inch. Body hook measurements beginning at least ½ inch to the right of the side seam should be taken at three equal locations around the perimeter of the can by using a seam micrometer. For most sizes of cans the maximum length of body hook should not exceed 0.090 inch. The minimum length should not be less than 0.070 inch.

Tightness Rating. The tightness rating is very important and should be evaluated carefully. This factor will determine whether the end sealing compound is being held under sufficient hydraulic pressure to insure sealing efficiency. In so doing, the compound will fill all spaces not being occupied by metal. The tightness rating is determined by the wrinkle in the cover hook. A wrinkle is the degree of waviness occurring the cover hook, indicating the tightness of the seam. Wrinkles are classified by number, and the rating is determined by the large wrinkles which are observed when examining the cover hook.

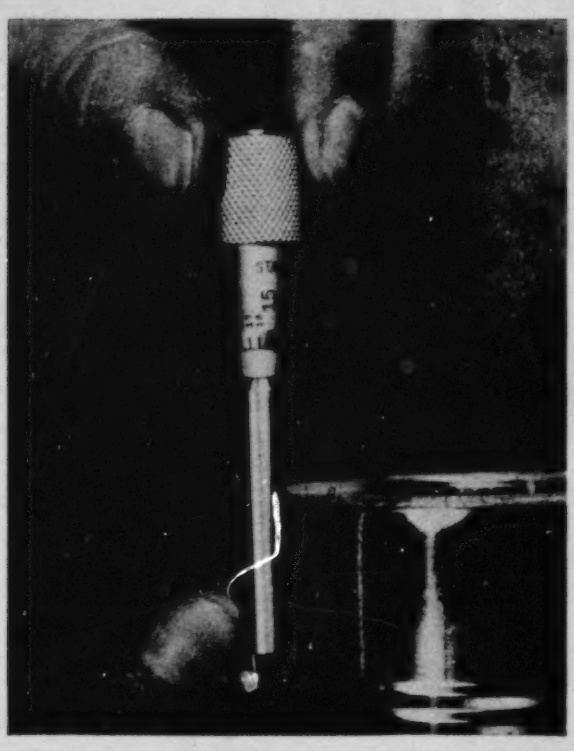


Figure I-19. Gauging a Body Hook with a Micrometer.

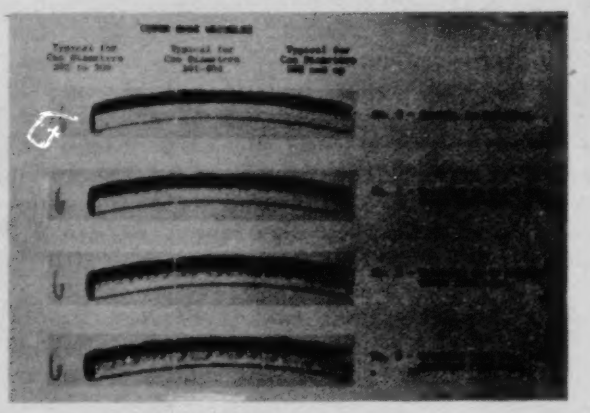


Figure I-20. Illustration of Cover Hook Wrinkles.

In small cans, under 301 diameter, it is important to note that ironed out first operation folds should not be confused with the normal wrinkle. The ironed out folds will be apparent only in tightly rolled seams.

In small diameter cans (202 to 404) wrinkles should not exceed No. 1. On larger than 404 diameter cans seams should have No. 0 wrinkles. In hemming a straight edge of tin plate, no wrinkles are formed. On curved edges, wrinkling increases as the radius of the curvature decreases. For this reason, different wrinkle ratings are specified for smaller diameter cans as compared to large diameter cans.

Note: The most critical leakage area is at the lap, or cross over. Observe the cover hook wrinkles adjacent to the cross over for signs of looseness or "jumped seams."

Pressure Ridge. The pressure ridge is formed on the inside of the can body directly opposite the double seam and is the result of the pressure applied by the seaming rolls during the seaming operation. The practice of visually inspecting the pressure ridge when a can is stripped is an additional safeguard against approving double seams which may not be as tight as they should be even though the measurements of the double seam and the cover hook wrinkle are within tolerance.

The pressure ridge, in appearance, should be clearly impressed around the complete inside periphery of that portion of the can body which is exposed when the cover countersink wall is removed when stripping the double seam for inspection. An excessively deep pressure ridge should be avoided on inside enameled cans. However, a pressure ridge should be present and clearly visible.

Steam-Jacketed Kettle

It is desirable to have several steam-jacketed kettles varing in sizes from 25 to 60 gallons for making fruit butters, tomato juice, soup stocks, rendering lard, and preheating products such as tomatoes, corn, apples, and juices. The kettles should be of stainless steel and equipped with a 1½ inch stainless steel outlet pipe and valve. The kettles should be located to provide sufficient work room around. Each kettle should be provided with a pressure reducing valve in the steam line to control the steam working pressure. A globe valve should be installed between the pressure reducing valve and the kettle for admitting steam to the kettle. In order that the operator may know at all times the pressure being admitted to the kettle, a steam pressure gage should be placed between the globe valve and the kettle. The pressure range on this gage should be from 0 to 60 psi.

Containers

The number of different sizes of containers used in canning centers should be kept to a minimum. This is because each size requires a different processing time and a can closing machine adjusted for that particular size.

The sizes of glass jars commonly used are pints and quarts. Occasionally 2-quart or ½-gallon jars are used for fruits, tomatoes, pickles, and other acid foods. The larger jars are not recommended for low acid foods. No processing times and temperatures are available on this size jar.

Cans. In the past, No. 2-, 3-, and 10-size cans have been most often used by community canneries. In recent years the popularity of the No. 2 and 3 cans have declined to the extent that manufacturers of the cut production of these sizes. Consequently, it has become increasingly difficult to obtain No. 2- and 3-size cans. These sizes are being replaced by 303- and 2½-size cans.

Tin plate for fabricating canned food containers came into use shortly after the discovery of the principle of the preservation of food by heating hermetically sealed containers. Although more than a century has passed since the first use of tin plate "cannisters" for this purpose, no material equal or superior to tin plate in economy, durability, and retention of wholesomeness of food has been found. With the advent of the sanitary style can, the tin plate container was improved for certain classes of foods by applying an enamel to the interior of the can. The purposes of the enamel lining are (1) to increase the attractiveness of the food, (2) to improve the appearance of the container, and (3) to make the container more resistant to internal corrosion.

In the manufacture of enamel-lined cans, the enamel is ordinarily coated on flat sheets of tin plate before manufacturing into can bodies. A uniform film is applied to the sheet of tin plate by a roller-coating process. On sheets to be manufactured into can bodies, narrow strips are left bare by the coating rollers to provide for the soldering of side seams. From the coater, the sheets are immediately conveyed through long ovens at high temperatures where the enamel is thoroughly baked on. This leaves only an insoluble, inert, resinous film on the tin plate. The cans are then formed from enameled sheets by the same fabrication methods as employed for sanitary cans made from plain tin plate.

Two types of enameled cans are most widely used: (1) fruit enamel, also known as "R" or sanitary enamel, and (2) C-enamel. Fruit enameled cans are used for all acid foods, such as fruits, tomatoes, colored fruits and berries. Beets and carrots are also canned in fruit enameled cans to preserve color. If plain tin cans are not available, green beans, salad greens, asparagus, and sweet potatoes can also be canned in fruit enamel cans. Vegetables, such as corn, peas, lima beans, dried beans and mixed vegetables, which contain sulfur compounds should be canned in C-enamel cans. Zinc oxide which is in the C-enamel lining reacts with the sulfur to form zinc sulphide which is harmless and white in appearance. If the zinc oxide was not present, the sulfur would react with the iron in the tin plate to form a black precipitate, iron sulphide, which would cause the food to become dark and appear unattractive. .Iron sulphide in this small quanitity would not be harmful. If enamel cans are not available for meat products, C-enamel can be used. However, meat products in C-enamel cans will not have as long a shelf-life as in meat enamel cans.

When possible, it is desirable from a standpoint of economy and convenience to purchase the supply of cans for a canning season at one time. It is also desirable to place orders during the season when canning activity is light. This is because can companies are usually looking for extra storage space and are more anxious to make sales. Savings of up to 15 percent can often be made by purchasing cans in truckload or carload lots. A truckload of No. 303 cans will contain from 25,000 to 30,000 cans and a carload will have 60,000 to 100,000 cans. There are 18,000 to 25,000 No. 2½ cans in a truckload and 38,000 to 60,000 in a carload. If at all possible, cans should be purchased in reshipping cartons for easy handling and storage and to minimize damage in shipment.

Glass Jars. Standard mason-type jars designed for home canning should be used when processing by the methods described in this manual. It makes no difference whether the jars are regular or wide-mouth. All jars should be of the type that can be sealed with two-piece metal closures. This is the only type of closure that is entirely satisfactory. It permits the jar to vent during the processing period even though the band is screwed down firmly and is self-sealing. Being of metal, the lid helps to absorb the initial shock to the jar when cold water sprays are turned on for cooling. Only new lids should be used. The screw bands may be reused if they screw down evenly. All jars should be carefully examined, whether new or previously used, for defects, such as cracks, chips, uneven sealing surfaces, rough edges on rims, or rims that are not perfectly round. Even the smallest defects may cause a poor seal. Feeling the tops of jars with the fingers is a good technique for determining uneven surfaces. Defective jars should be discarded. Glass jars that are not intended for canning, such as coffee or mayonnaise jars, should never be used. Such jars are not manufactured to withstand the heat required in processing foods, and are likely to break during processing and cooling.

If the proper jars are used and the correct methods of handling and processing are followed, breakage should not exceed three jars per thousand processed.

General Canning Procedure

Receiving Produce. Families using the canning center should be assigned a permanent identification number. As they arrive with their produce, they should label or tag containers of food with this number. Proper identification is essential if it is necessary to refrigerate or hold over the produce. If families bring more produce than can be handled promptly, it should be stored in a cool, well-ventilated place, and preferably on slatted racks.

Family groups and others should be advised against canning unripe fruit or tomatoes, wilted vegetables, produce showing marked signs of spoilage, and produce which has matured beyond the stage for successful canning. In the event that some persons insist upon canning such produce, the canning should be delayed until after the other patrons have finished

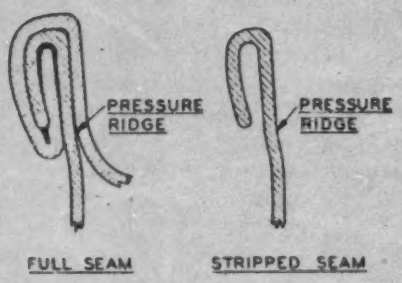


Figure I-21. Pressure Ridge Produced in Making a Good Double Seam.

Figure I-22. A Two-Piece Jar Closure.

so that produce showing spoilage will not contaminate the good produce of other patrons. When undesirable produce is canned, extra care will be needed afterward in cleaning and sanitizing the preparation area, equipment, and other processing facilities to prevent contamination of foods in subsequent operations.

Families do their own work and should be requested to bring sufficient help. The lay instructor assigns preparation space, issues the necessary equipment, and keeps all the necessary records. Upon completion of the canning work, those patrons using the center should thoroughly clean and return all equipment to the lay instructor. The lay instructor should then check the equipment against the record and return it to the storage room. Patrons of a cannery should not be permitted in the storage room.

The lay instructor should always explain the steps in the preparation of food according to the sequence of operations and stress the necessity for cleanliness and prompt handling of foods.

Preparation Procedure for Canning. Several important procedures in the preparation of food for canning are discussed below.

Grading. Grading means separating according to size, maturity, and quality. The purpose is to facilitate canning operations. Grading for uniformity of size is necessary where heat penetration in processing is a factor or where produce is to be steamed for peeling. For example, beets are sorted according to size so that they may be steamed uniformly for peeling. The smaller beets may be packed whole and, because of tenderness and flavor, this results in a higher quality product. The larger beets, due to size and advanced maturity, must be sliced or otherwise cut into suitable size pieces to insure heat penetration during processing.

Sorting. Sorting, as is most commonly used, refers to inspection of the product to be canned to detect and remove any extraneous material, such as grass and weeds from greens and silk and husk from cut corn, and any individual pieces of the product which may be unsuitable for use or which may require special treatment, such as trimming away worm eaten or diseased parts. All bruised, shriveled, discolored, or soured portions should be discarded. While sorting, immature and over-ripe produce should be removed.

Trimming. The final quality, grade, and value of many canned foods may depend on the efficiency of the persons responsible for trimming and sorting. Trimming should be continued through all steps of preparation and questionable pieces and portions should be removed rather than risk spoilage or having a low-quality finished product.

Soaking and Washing. Thorough cleaning is one of the first and most important steps in food processing. All vegetables and most fruits require considerable cleaning and

washing before the processing. Root crops may require soaking before washing. This step will slow up preparation time unless the washing equipment is properly arranged or the soaking and washing is done before the produce is brought to the cannery. The purpose of cleaning and washing is to remove dirt and foreign material. Cleaning and washing also serves to reduce the amount of spoilage organisms that are usually present on raw foods.

A clean, safe, and ample water supply is absolutely necessary. Ample quantities of water should be used to permit moving and turning of the produce. Washing should be so thorough and complete that the produce will need no further cleaning before processing.

Cutting, Breaking, Peeling. All products should be cut or broken into uniform sizes. This permits the container to be filled properly and facilitates heat penetration during processing.

Peeling ordinarily is accomplished by one of the following methods:

(1) Hand Peeling. This is the simplest and most common method. It may be performed on raw products but is usually done after the product has received a hot water or steam treatment, known as "scalding." The purpose of scalding is to loosen the peel so that it may be removed easily. Tomatoes and peaches may be peeled in this manner.

(2) Steam Peeling. With steam peeling, a heat temperature is used to loosen skin from some fruit and root vegetables. Steaming is also used to break down or soften for pulping foods, such as pumpkin, pears, apples, and tomatoes. Steaming for peeling is usually done in a steam blancher-cooler. Some products, such as beets, are steamed under pressure for peeling.

The product should be steamed only long enough to loosen the skin but not to cook the product. Produce should be graded for size and maturity. The time of steaming should be adjusted accordingly to avoid uneven results. Produce that has been kept in storage will require a longer time for steaming than that which is fresh.

When steaming is done to soften the product for pulping, a steam-jacketed kettle, enough water to prevent sticking and provide steam inside the kettle to steam the product should be

used. If a retort is used, the product should be placed in a stainless steel or aluminum pan or basket. Only produce of the highest quality should be used. In addition, the produce should be washed carefully and cut into uniform pieces for even steaming. Peels and rinds are usually left on since they are removed in the pulping process.

(3) Lye Peeling. This method of peeling is used for many root crops and for some fruits. The principle is simple in that the product is merely immersed in a hot lye solution for a period of time, removed, and washed immediately with water to remove the peel and excess lye.

The lye bath is never used to remove the skin from the product. It is used only to treat the surface in such a manner that the skin can be easily removed by a spray of water. The product should always be removed from the lye bath with the skin still adhering and in a soft and somewhat gelatinous condition. The skin should be loose enough to wash off easily. The removal of too much skin in the lye solution results from overexposure or too much stirring of the product. Continued overexposure of the product to the lye bath causes gradual thickening of the solution to the point where it can no longer be used and must be replaced. Overexposure is expensive and wasteful. A very gradual thickening of the lye solution is a normal occurrence because of accumulated skins. All skins should be removed in the first washing operation after treatment of a product with a lye solution. Experience has shown that best results are obtained when the temperature of the solution is as near boiling (101°C. or 214°F.) as possible and never below 93.3°C. or 200°F.

It is impossible to set up a definite formula for a lye solution to peel a given product. Several examples are cited. Ripe peaches peel quicker than those which are less mature. New potatoes peel faster with a weaker solution than those which have been cured. Freshly dug carrots and sweet potatoes peel more quickly than those which have been in transit or storage for several days or longer. The formula for the starting solution for each product and the directions for proper use can, however, be given. The starting solution is one which will, under perfect conditions, peel efficiently.

The strength of the solution is based on the assumption that it will be used at the recommended temperature, since peeling is actually accomplished by a combination of temperature and strength of solution. If a product to be peeled does not emerge in properly peeled condition, small amounts of lye must be added until the desired peeling effect is produced.

Lye (caustic soda) is a strong alkali. Body contact with lye solutions can result in chemical burns unless immediately rinsed away with water or neutralized with a weak acid, such as vinegar, boric acid, or lemon juice. Where the open vat method is used, it is essential that the operator of the lye-peeling equipment wear goggles, rubber gloves, rubber apron, and rubber boots. Proper protection should aid in preventing any possible accident to the eyes, hands, clothing, and shoes. Boots are essential if the equipment being used allows the solution to drip onto the floor. Never use lye in an aluminum container. Lye readily reacts with aluminum and will render the container useless in a short time. It is safe to use lye in enameled ware, wrought iron, or stainless steel containers. Lye will damage wool and leather. Its effect on cotton is slight. A small speck of lye solution in the eyes can result in painful injuries and, possibly impairment of sight.

Caution: Lye should be added to water slowly to prevent foaming and boiling over on the floor and possibly getting on the feet of workers.

Discoloration of Fruits and Vegetables. Discoloration in peaches, pears and apples can be avoided by rapid preparation. When delay cannot be avoided after the fruit is peeled and cut, the pieces of fruit may be placed in a salt and vinegar solution. This solution is made by adding 2 tablespoons of salt and 2 tablespoons of vinegar to a gallon of cold water. Other products that oxidize rapidly after peeling are white potatoes and eggplant.

Some products also are discolored through the use of knives that have iron blades or when the cut pieces are placed in copper, iron, or galvanized iron containers. It is best to use stainless steel, aluminum, or enameled containers. Beets will oxidize after steaming if preparation is not completed promptly. It is important to use the proper type of can lining to avoid discoloration of canned products after normal storage.

Discoloration by oxidation may also be present in canned foods when (1) head space is too great, (2) the container is not properly filled with the medium, or (3) exhausting has been insufficient. This type of defect is not necessarily accompanied by spoilage.

Blanching. Blanching is an operation in which raw foods are immersed in hot boiling water or exposed to live steam. Blanching is important because it accomplishes a number of purposes in one operation, as follows:

(1) Expulsion of respiratory gases. The expulsion of these gases through the shrinkage of the product is necessary to prevent strain on the can during processing. If dissolved and occluded gases within the cells of the raw food are not removed, serious damage to the product may occur as a result of physical or chemical activity, or both. Apples, for example, can be very corrosive to metal containers because of high acidity and air content. Failure to remove the air from apple cells increases corrosive action. This is a result of the combined effect of oxygen and acid in the fruit on the container. Corrosion often produces hydrogen gas resulting from the chemical action of the acid upon the metal. Swelling or "springing out" of one end of a can may result. This condition causes strain on the can and combined with corrosion, may result in perforations (holes) in the container and spoilage of the food.

Gases expand or increase in pressure with a rise in temperature and, if not removed from the food before sealing the container, may cause "buckles" and strained ends in the can during the sterilization process. This is due to pressure inside the can being greater than the can is designed to withstand. This condition may result in spoilage. The oxygen in the gases, if not expelled, will oxidize some of the vitamins and make the food less nutritious.

(2) Shrinkage, wilting and increased pliability. These three effects brought about through blanching promote adequate filling of containers. Crisp foods, such as apples or pears, are easily broken if not treated in some manner to increase pliability. Blanching in steam softens fibrous plant tissues and permits handling and filling into containers with a minimum amount of breakage and tear. Shrinkage resulting from the removal of the gases and some of the moisture content in the product makes it possible to obtain a well-filled container.

(3) Removal of undesirable flavors and materials. If undesirable flavors and materials are not removed from raw produce, objectionable flavors or an unattractive

appearance may result in the finished product. In the case of peas and lima beans, blanching removes a sticky, gelatinous substance which, when present, might contribute to an increase in potential spoilage organisms.

(4) Inhibits or checks further enzymatic action. Inhibition of enzymes, especially those inducing oxidative reaction, yields products of superior quality and nutritive value.

(5) Blanching to "set" or "fix" the natural color. This was overlooked in certain products for a number of years. Blanching improves the color and appearance of processed products.

(6) Blanching serves as an added cleaning measure. Blanching helps to insure a more wholesome canned product.

Two main methods are commonly used in blanching food products for canning and freezing. These are (1) boiling water immersion and (2) steam. Steam blanching is recommended over immersion in boiling water because less of the water-soluble nutrients are lost by the steam method.

A steam blancher-cooler is recommended because: (1) it is well-suited to batch operation, especially when several commodities are being simultaneously prepared for processing; (2) it requires less steam and water; (3) in most instances, a more desirable color can be obtained because the needed 100°C. (212°F.) temperature can be maintained more uniformly and easier.

All blanching equipment should be checked and cleaned frequently. Blanching equipment is used over and over. The high temperature and moist atmosphere are favorable to the development and growth of the thermophilic or "heat loving" types of bacteria. If spoilage organisms are allowed to accumulate on blanching equipment, a whole pack of containers may become contaminated. Not only should all blanching equipment be "washed-down" frequently during operation, but the equipment should be cleansed as thoroughly as possible after each day of operation and rinsed well before processing operations are resumed the next day.

Filling Containers

One of the most important steps in the canning procedure is the proper filling of the containers. Under-filling may cause buckling of the cans due to the excessive amount of air in the large amount of headspace. The expansion of this large quantity of air will probably cause the cans to buckle during processing. The large quantity of air left in the headspace will also cause the product to darken due to oxidation. Over-filling can also cause buckling and the ends to protrude beyond the the point where they will remain convex, instead of becoming concave, after cooling. All containers should be filled so that there will be 1/4 to 3/8 inch headspace after all solids have been completely covered with the liquid filling medium. As an aid in obtaining the proper fill,

a pair of "over and under" scales are useful. Cans should never be filled beyond the stated content for each size.

All products should be packed into containers immediately after preparation. Those products to which heat has been applied in preparation will deteriorate rapidly if left standing at room temperature. If packed promptly while hot, the time of exhausting to the recommended center-can temperature will be shortened. Discoloration may occur if fruits, such as peaches, pears, and apples, are left to stand after preparation.

A canning medium is a brine, syrup, or juice used to cover a product after the container has been filled. A 1/4 inch headspace should be allowed. Care should be exercised in choosing salt. Canners salt or dairy salt which may be purchased from any salt manufacuturer, is preferred since it dissolves faster and stays in solution better than table salt. Salt tablets may be used. Iodized salt or any salt with a filler added to prevent lumping should not be used for canning.

Syrup is used with most fruits and sweet potatoes. The correct proportions of sugar to water should be followed in making various types of syrups.

In making brine or syrups, water that is exceptionally hard or that contains an excessive amount of iron or other minerals should not be used. In some localities it is necessary to treat or filter water to make it usable. Clean salt and sugar should be used in making brines and syrups. The use of unclean salt or sugar could be a source of contamination for the food.

Exhausting

Exhausting is the heat treatment given after the cans are filled and before they are sealed. It is normally the last operation in the canning procedure before the containers are closed. Exhausting is to remove trapped air and the cellular and head-space gases from the container prior to closure. This may be accomplished by heating the product to expand the gases just before the container is sealed. Several reasons have been given for expelling the air and other gases from the product and container:

(1) Exhausting reduces corrosion on inside of container during storage. Dissolved and occluded gases within the cells of the raw product may not be completely expelled during blanching. Most fruits are not blanched but are packed into the container without removal of air from the fruit cells. Dissolved and occluded gases within the cells of the raw product, if not removed before canning, may cause serious damage to the product as the result of physical or chemical activity. Corrosive action is greatly increased as a result of the combined effect of oxygen and food acids on the container. Corrosion may

produce perforations (pinholes) in the container resulting in spoilage of the food.

(2) Exhausting preserves color, flavor, and vitamins. Removal of oxygen before closure of a container is necessary. Many of the desirable qualities of foods are destroyed or altered if the product is heated or retorted for relative long periods of time in the presence of oxygen or when held in storage with appreciable amounts of oxygen present in the container. The color of the food may become abnormally light or dark, the flavor may become slightly bitter, fats become rancid and other changes might occur in the food.

(3) Exhausting helps to prevent container failure. It is necessary to remove the air and gases from the food and container in order to prevent the occurrence of buckles and strained ends during retorting. Since gases expand or increase in pressure with a rise in temperature, the gases in foods, unless removed before container closure, will exert undue strain on the container during the sterilization process. When the difference in pressure between the inside and the outside of the can is greater than the can is designed to withstand, buckling or serious injury to the can closure occurs. Spinach or turnip greens may be well blanched, but may produce severe buckling of the container if the air trapped in the can during the filling operation is not removed.

(4) Exhausting produces a vacuum in the sealed container when stored at room temperature. As much vacuum as can be obtained is desired in extremely corrosive products. Reaction of this type of product upon the container produces hydrogen gas, which may cause the ends to bulge. The higher the vacuum, the longer the shelf-life of a product. The exhaust must be regulated so as to produce the greatest vacuum practicable without producing excessive "panelling." With larger size cans, the vacuum should not be so great that panelling occurs during normal handling.

Can-Closing Temperature in Relation to Vacuum. The center-can closing temperature is the temperature of the contents of a can at the slowest heating point in the can at the time the can is sealed. The slowest heating point in products that heat by convection is about halfway between the center and the bottom of the can. Products canned in a medium, such as brine and fruit in syrup, heat by convection. The slowest heating point in products that heat by conduction is at the center of the can. Products such as pumpkin, mashed sweet potatoes, cream-style corn, and ground meat (solid pack) heat by conduction.

In order to maintain the canned product in good condition, it is necessary to have a proper vacuum. The ends of the can should contract or "pull-in" on cooling and remain concave under average conditions. The vacuum produced after processing and cooling will vary with the can-closing temperature. The can-closing temperature is the temperature of the contents of the can at the time of sealing. For products packed in a liquid medium in number 2½ (401 x 411) or smaller cans, the can-closing temperature should be at least 79.4°C. (175°F.) to assure proper vacuum. For products packed in a liquid medium in number 10 (603 x 700) cans, the product is usually exhausted until a temperature of 71.1°C. (160°F.) is obtained.

Initial Temperature. The term "initial temperature" designates the temperature at the center of the can at the time the retort reaches processing temperature. Where an initial temperature is specified in the instructions for processing time, it should be regarded as a prerequisite of the process given for that product. The coolest can in any retort load should have an initial temperature equal to or greater than the temperature specified for the product. If a can is closed at the recommended center-can closing temperature and is then held for some time before it is processed, the initial temperature will be lower than the closing temperature.

Sealing

Sealing, or the permanent closing of the can, must be done as rapidly as possible following the exhausting. The sealer must be properly adjusted before sealing operations begin. If not, there may be delays which impair the quality of the product or cause spoilage. As cans are sealed, periodic inspections should be made to determine whether the sealer is in need of adjustment. As lids are placed on cans before sealing, it is also a good practice to check the fill of the container.

Glass jars should be sealed promptly after filling, as follows:

(1) Check the rim of the jar to make sure no particles of food will be caught between the lid and the jar.

(2) Place the lid on the jar so that the sealing compound is next to the glass.

(3) Screw the metal band down evenly with the fingers -- not with the palm of the hand. Over-tightening of the band may prevent proper venting of the jars during processing. Food contents in jars are not exhausted by heating just before sealing as food in cans is. Jars are exhausted during processing, therefore, the bands should not be too tight.

(4) Do not tighten the band further after the jars are processed. Any attempt to do so may break the seal.

Summary

The term "processing" designates the heat treatment in terms of temperature and time given a product after the container is permanently sealed. The basic or minimum requirement for the processing of any product is that it be heated sufficiently to destroy bacteria of known resistance to heat. In some cases the count of spoilage bacteria may be so high that the suggested processing time and temperature may be inadequate to prevent spoilage. It is, therefore, essential to keep the bacteria count as low as possible by following approved methods in the preparation of food products.

In the processing of canned foods, it is always assumed that the heat-resistant micro-organisms will be located at the slowest heating point of the contents of the can. Until this point receives adequate heat, the contents of the can are not sterilized sufficiently to control the bacteria. Processing times are partly based on the rate at which heat is transferred to this point. Heat is transferred by both convection and by conduction. In the processing of canned foods packed in liquids, such as peas, snap beans and beets, heat transference takes place mainly by convection and the rise in temperature is fairly rapid. Any substance which retards convection currents decreases heat transference.

Solid foods heat by conduction and the process is relatively slow since there is no transfer of material from hot to the cooler part of the can. In products that heat slowly, such as pumpkin, squash, and sweet potato puree (solid pack), the initial temperature is part of the process as it determines the length of processing time that will be required to make the product keep safely. Both methods of heat transference occur in tomato juice and fruit juices containing pulp. Therefore, longer processes are required for these juices than for juices which have been strained and the particles removed.

The sterilization of each container during "processing" in the retort is related to the maintenance of the temperature present during exhausting. The higher the "initial" temperature at the beginning of processing, the greater the efficiency in destroying heat resistant bacteria during processing. It is most important, therefore, that all containers be processed immediately or as soon as possible after sealing and before the contents of the container lose the initial temperature.

Water-Bath Processing. The boiling-water process is used for acid products, such as fruit, tomatoes, and sauerkraut. The temperature obtained (100°C. or 212°F.) is sufficient to kill all actively growing bacteria, molds, and yeasts. The acid in the food tends to prevent the growth of any heat resistant spores that may be present. Fruit juices free from pulp can be preserved by pasteurizing them in water at 82.2°C. (180°F.) for 20 minutes, provided the containers are filled while hot. Tomato juice which contains considerable pulp must be processed in a boiling-water bath.

The water-bath method may be duplicated by processing in a closed retort at approximately 2 pounds steam pressure or 102.2°C. (216°F.). This will produce a transfer of heat throughout the containers equal to a boiling water bath.

Steam Pressure Processing. The steam-pressure process is used for low-acid foods, such as vegetables, meats and fish. In order to sterilize low-acid foods effectively in a reasonable period of time, it is necessary to use a steam atmosphere at a controlled temperature of 115.5°C. (240°F.) or 121.1°C. (250°F.). The retort used for this purpose is essentially an autoclave, or closed kettle, designed for processing or cooking canned foods.

In processing such products, the complete elimination of air from the retort is a vitally important factor. This is known as "venting." The time consumed in bringing the retort to processing temperature at the start of the process is known as the "coming-up" or "come-up" time.

The importance of properly venting the retort during the "come-up" time cannot be overemphasized. Inadequate elimination of air or gases in the retort may be the direct cause of such difficulties as paneled cans, rusted cans, spoilage due to under-sterilization or non-conformity of cook between different containers in the retort.

During the process in the steam-pressure retort, a small amount of steam must be released throughout the period of process to insure maximum circulation of heat and the elimination of gases which may enter with the steam. This is known as "bleeding." All retorts should be equipped with a bleeder or small 1/8 inch petcock installed in the lid of the retort.

Cooling Containers. The cooling of containers (tin and glass) after processing is a very important step in canning. Rapid cooling accomplishes two things: (1) deterioration because of over-cooking is minimized and (2) the temperature of the product is reduced below the ideal germinating temperature of heat-loving bacteria. These bacteria are not completely destroyed by temperatures used in processing. It is fortunate that these bacteria will not germinate at ordinary room temperature. Therefore, spoilage due to organisms of this type can be controlled by cooling the product below the germinating temperature, which is about 43.3°-62.8°C. (110°-145°F.).

Prompt cooling of containers immediately after processing will prevent (1) stack burn in products such as corn and tomatoes, (2) cloudy brine or liquid in peas, string beans, lima beans, whole grain corn, (3) pink discoloration in light colored fruits such as pears, and (4) softness or loss of texture in berries, fruits, and leafy vegetables. Prompt cooling lessens cooked flavor, conserves natural color, and retards action of food acids on the container. All glass jars and number 2½-(401 x 411) size cans and larger, processed under pressure, must be cooled under pressure. Follow closely the instructions for cooling under pressure. Can sizes number 2 (307 x 409) or smaller, do not require pressure cooling and may be removed from the retort immediately after processing to be cooled in a cooling vat or under sprays.

Only potable or chlorinated water should be used for cooling since the contraction of the cans as the vacuum is produced during cooling may draw water into the cans. If there are impurities, spoilage may result. The water-cooling period should be sufficient to bring the temperature of the product to 35°-37.8°C. (95°-100°F.). This temperature should be low enough to prevent the growth of bacteria and high enough to dry the cans and prevent rusting.

Storage. Place canned foods in a dry, well-ventilated space. Products packed in glass jars should be stored in a dark place to prevent loss of color or color change. The temperature should be as near constant as is possible and moderately cold but not freezing. Avoid storage space in attics, near steam pipes, radiators, or stoves, as high storage temperatures may impair the flavor, texture, and color of the canned products, and the excessive moisture will cause the cans to rust. Cannery patrons should be encouraged to report spoilage immediately and to return the containers of spoiled products to the canning center in order that the cause may be determined and future losses from spoilage be prevented.

Part II

Canning Specific Food Products

The purpose of Part II of this publication is to present the detailed procedures in canning specific food products. Each product is discussed in terms of canning in either glass jars or cans. The food products are presented in three sections: fruit (including fruit juices); vegetables; and meat, meat products, and poultry. The first page of Part II presents basic information on the appropriate yield that can be obtained from a given quantity of food.

Yields of Various Food Products

The yields of various fruit and vegetable products are presented in Table 2. This should be helpful in determining the number of jars needed for a given quantity of food. The quantity of meat required to fill pint and quart-size jars is presented in Table 3.

Table 2

Yields of Various Fruit and Vegetable Products

Produce	Wt. Per Bushel	Pint Jars	Quart Jars	2-Quart Jars
	Pounds	No.	No.	No.
Apples	48	36	18	9
Apricots	48	42	21	10
Asparagus	45	22	11	--
Beans, green lima (in pods)	32	14	7	--
Beans, green and wax	30	35	17	--
Beets (w/o tops)	52	37	18	--
Berries	36	30	15	8
Carrots (w/o tops)	50	36	18	--
Cherries	56	53	26	13
Corn, sweet (in husks)	35	17	8	--
Peaches	48	44	22	11
Pears	50	45	23	12
Peas, green (in pods)	30	14	7	--
Spinach	18	15	7	--
Squash (summer)	40	36	18	--
Sweet potatoes	55	40	20	--
Tomatoes	56	38	19	10

Table 3

Quantity of Meat Required to Fill Jars

	Quantity required to fill a	
	Pint Jar	Quart Jar
	Pounds	Pounds
Beef, round (untrimmed)	1 3/4 to 2	3 to 3 1/2
Beef, rump (untrimmed)	3 to 3 1/3	5 to 5 1/2
Chicken (dressed, undrawn) to be canned with bone	2 3/4 to 3 1/3	4 1/2 to 5 1/2
Chicken (dressed, undrawn) to be canned without bone	4 1/4 to 4 3/4	7 to 8
Pork loin (untrimmed)	3 to 3 1/3	5 to 5 1/2

Use of Sugar in Canning Fruit

Fruits and fruit juices may be canned with or without sugar.

The syrup should be prepared in advance of the time it is to be used. Reheat to boiling point before filling cans. From 3/4 to 1 cupful of syrup should be allowed for each #2 can of fruit. The use of sugar helps to preserve the color, texture, and flavor of fruit.

The following table gives the proportion of sugar and water for various syrups.

Table 4

Proportions of Sugar and Water for Syrups

Percentage of Sugar	Consistency of Syrup	Sugar Needed per Gallon of Water	Dry Sugar per #2½ Can
20%	Light	2 lbs., 2 oz. or 5 cups	1/8 cup
30%	Moderately light	3 lbs., 10 oz. or 2 qts.	1/4 cup
40%	Medium	5 lbs., 9 oz. or 3 1/8 qts.	1/3 cup
50%	Moderately heavy	8 lbs., 6 oz. or 4 3/4 qts.	1/2 cup
60%	Heavy	12 lbs., 8 oz. or 7 qts.	3/4 cup

Apple Butter

Select apples

Select fully ripe, sound fruit. Parings and cores of canning apples may be used in the preparation of apple butter.

Prepare cans or glass jars

Use #2, #2½, or #10 cans, or pint, quart or ½ gallon glass jars having self-sealing closures. Wash cans or jars.

Prepare apples

a. Wash apples thoroughly.
b. Remove spots, bruised portions and blemishes. Do not peel.
c. Cut the apples in section and remove blossom and stem ends.

Precook and sieve

a. Cook in a small amount of water; not more than half as much water as fruit.
b. Put cooked apples through pulper or sieve to remove skins, cores and seed.

Recipe

3 gallons apple pulp
3 pounds sugar (brown or white)
2 teaspoons ground allspice
2 teaspoons ground cloves
1½ teaspoons ground cinnamon

a. Set aside.
b. Combine pulp and sugar and cook in steam jacketed kettle until product is thick and smooth, stirring frequently to prevent scorching.
c. Ten minutes before cooking is completed, add spices mixed in small amount of cold water.
d. Product is cooked when liquid does not separate after a spoonful is dropped on a saucer.

Fill

Cans: Fill cans with hot apple butter to within 1/8 inch of top.

Glass Jars: Fill jars to within ½ inch of top with hot apple butter.

Exhaust

Cans: Bring center of can temperature to 180°F.

Glass Jars: Insert table knife blade down the sides of jars to remove air bubbles.

Close

Cans: Place marked covers on cans and seal at once.

Glass Jars: Wipe tops of jars with clean, damp cloth. Adjust lids.

Process

Cans:

a. Process at once in boiling water bath. (212°F.)
b. Processing time:

Size	Time
#303	10 minutes
#2	10 minutes
#2½	10 minutes
#10	10 minutes

c. Remove cans from cooker as soon as processing time is completed.

Glass Jars:

a. Process at once at 212°F.
b. Processing time:

Size	Time
Pints	15 minutes
Quarts	15 minutes
½ gallon	15 minutes

Cool

Cans: Cool cans.

Glass Jars: Cool jars.

FRUIT — Apples (Sliced or Quartered)

Select apples

Select ripe, firm fruit. Sort and remove faulty fruit.

Prepare cans or glass jars

Use #2, #2½ or #10 cans, or pints, quarts or ½ gallon glass jars having self-sealing closures. Wash cans or jars.

Prepare apples

a. Wash with cold water.
b. Remove spots, seeds, stem and bud ends. Peel if preferred.
c. Cut into slices or quarters.
d. Drop into cold water, adding 2 tablespoons each of salt and vinegar to each gallon of water.

Precook

a. Drain apples.
b. Boil apples in thin syrup or water for 5 minutes or until tender, or
c. Cook slowly in steam jacketed kettle, or with steam until tender.
d. One-half cup sugar to each quart of apples may be added.

	Cans	Glass Jars
Fill	Fill cans with apples to within ½ inch of top. Add cooking liquid or syrup to completely fill.	Fill jars with apples to within ½ inch of top. Add cooking liquid or syrup to within ½ inch of top.
Exhaust	Bring center of can temperature to 180°F.	Insert table knife blade down the sides of jars to remove air bubbles.
Close	Place marked covers on cans and seal at once.	Wipe off tops of jars with clean, damp cloth. Adjust lids.
Process	a. Process at once in boiling water bath. (212°F.) b. Processing time: Size — Time #303 — 10 minutes #2 — 10 minutes #2½ — 10 minutes #10 — 10 minutes c. Remove cans from cooker as soon as processing time is completed.	a. Process at once at 212°F. b. Processing time: Size — Time Pints — 20 minutes Quarts — 25 minutes ½ gallon — 30 minutes
Cool	Cool cans.	Cool jars.

Apple Sauce

Select apples
Select ripe, cooking apples.

Prepare cans or glass jars
Use #2, #2½ or #10 cans, or pint or quart glass jars having self-sealing closures. Wash cans or jars.

Prepare apples
a. Wash with cold water.
b. Cut into quarters. Do not peel.
c. Remove spots, seeds, stem and bud ends.
d. Drop into cold water, adding 2 tablespoons each of salt and vinegar per gallon.

Precook
a. Drain apples.
b. Add just enough fresh water to keep apples from sticking.
c. Cook slowly in steam jacketed kettle or under steam drop until tender.
d. Put through colander to remove skins.
e. One-half cup sugar to each quart of sauce may be added.
f. Return to steam jacketed kettle and bring to 212°F.

	Cans	Glass Jars
Fill	Fill cans to top with boiling apple sauce.	Fill jars to ¼ inch of top with boiling apple sauce.
Exhaust	Bring center of can temperature to 180°F.	Insert table knife blade down the sides of jars to remove air bubbles.
Close	Place marked covers on cans and seal at once.	Wipe tops of jars with clean, damp cloth. Adjust lids.
Process	a. Process at once in boiling water bath. (212°F) b. Processing time: Size — Time #303 — 10 minutes #2 — 10 minutes #2½ — 15 minutes #10 — 20 minutes c. Remove cans from cooker as soon as processing time is completed.	a. Process at once at 212°F. b. Processing time: Size — Time Pints — 15 minutes Quarts — 15 minutes
Cool	Cool cans.	Cool jars.

FRUIT — Berries

Select berries

Select ripe, firm fruit. Overripe berries should be used for juice or jams. Berries should be canned immediately after picking.

Prepare cans or glass jars

Use #2, #2½ or # 10 R-Enamel cans and pint, quart or ½ gallon glass jars having self-sealing closures. Wash cans and jars.

Prepare berries

a. Wash with cold water, using colander or wire basket.
b. Dip up and down and drain.
c. Remove caps, stems and berries not suitable for canning.
d. Berries may be precooked in syrup or packed raw and covered with syrup.
e. Prepare and use light or medium syrup according to syrup chart.

	Cans	Glass Jars
Fill	Put berries in cans shaking to secure a full pack. Fill cans to top with boiling hot syrup.	Put berries in jars shaking to sesure a full pack. Fill jars to within ½ inch of top with boiling hot syrup.
Exhaust	Bring center of can temperature to 160°F.	Insert table knife blade down sides of jars to remove air bubbles.
Close	Place marked covers on cans and seal at once.	Wipe tops of jars with clean, damp cloth. Adjust lids.
Process	a. Process in boiling water bath. (212°F.) b. Processing time: Size — Time #303 — 15 minutes #2 — 15 minutes #2½ — 20 minutes #10 — 25 minutes c. Remove cans from cooker as soon as processing time is completed.	a. Process at once at 212°F. b. Processing time: Size — Time Pints — 15 minutes Quarts — 20 minutes ½ gallon — 25 minutes
Cool	Cool cans.	Cool jars.

Cherries

Select cherries

Select well ripened, firm, clean fruit. Sour cherries are pitted and packed in water or syrup for use in pies and cobblers. Sweet cherries are used for desserts or salads and are usually canned without being pitted. Cherries should be canned immediately after picking.

Prepare cans or glass jars

Use #2, #3, or #10 R-Enamel cans, or pint, quart or ½ gallon glass jars having self-sealing closures. Wash cans or jars.

Prepare cherries

a. Wash cherries carefully.
b. Chill in ice cold water for 10 minutes.
c. Pit the cherries.
d. If cherries are to be sweetened, prepare a medium syrup (sour cherries) or light syrup (sweet cherries).

	Cans	Glass Jars
Fill	Fill cans to within ¼ inch of top with raw cherries. Fill to top with hot syrup or hot cherry juice or water.	Fill jars with raw cherries. Shake cherries in jars to secure a full pack. Fill jars to within ½ inch of top with boiling syrup, cherry juice, or water.
Exhaust	Bring center of can temperature to 160°F.	Insert table knife blade down the sides of jars to remove air bubbles.
Close	Place marked covers on cans and seal at once.	Wipe tops of jars with a clean, damp cloth. Adjust lids.
Process	a. Process in boiling water bath. (212°F.) b. Processing time: Size — Time #303 — 15 minutes #2 — 15 minutes #2½ — 20 minutes #10 — 30 minutes c. Remove cans from cooker as soon as processing time is completed.	a. Process at once at 212°F. b. Processing time: Size — Time Pints — 25 minutes Quarts — 30 minutes ½ gallon — 35 minutes
Cool	Cool cans.	Cool jars.

FRUIT

Fruit Juices

(Berries, Red Cherries, Currants, Grapes, Plums, or Blends of Fruits)

Select fruit
Use only sound, well ripened fruit.

Prepare cans or glass jars
Use #2, #2½, or #10 R-Enamel cans, or pint, quart or ½ gallon glass jars having self-sealing closures. Wash cans or jars.

Prepare fruit
a. Wash the fruit.
b. Remove caps or stems.
c. Crush fruit.

Precook and strain
a. Heat gently to 170°F. (below simmering) until soft.
b. Strain through a clean cloth bag. Re-strain to give clearer juice.
c. Add sugar, if desired -- ½ to 1 cup sugar to 1 gallon of juice.
d. Heat to 170°F. (below simmering).

	Cans	Glass Jars
Fill	Fill cans to top with hot juice.	Pour hot juice into clean, hot jars. Fill jars to within ¼ inch of top.
Exhaust	Bring center of can temperature to 160°F.	Insert table knife blade down sides of jars to remove air bubbles.
Close	Place marked covers on cans and seal at once.	Wipe tops of jars with clean, damp cloth. Adjust lids.
Process	a. Process at once in water bath at simmering point, 180°F. b. Processing time: Size — Time #303 — 20 minutes #2 — 20 minutes #2½ — 20 minutes #10 — 20 minutes c. Remove cans from cooker as soon as processing time is completed.	a. Process at once at 212°F. b. Processing time: Size — Time Pints — 5 minutes Quarts — 5 minutes ½ gallon — 5 minutes
Cool	Cool cans.	Cool jars.

Peaches

Select peaches
Select ripe, firm fruit.

Prepare cans or glass jars
Use #2, #2½, or #10 cans, or pint, quart or ½ gallon glass jars having self-sealing closures. Wash cans or jars.

Prepare peaches
a. Wash with cold water.
b. Place peaches in blanching basket and dip into boiling water until skins slip off easily.
c. Dip into cold water for a few seconds.
d. Peel, remove spots, and halve or slice peaches. Discard pits.
e. Drop into cold water containing 2 tablespoons each of salt and vinegar to each gallon of water.

Prepare syrup
Use medium or light syrup as required.

	Cans	Glass Jars
Fill	Pack raw peach halves into cans, cut side down, to within ½ inch of top. Fill to top with boiling hot syrup.	Pack raw peach halves into jars, cut side down, to within ½ inch of top. Cover fruit with boiling hot syrup leaving ½ inch space at top of jar.
Exhaust	Bring center of can temperature to 160°F.	Insert table knife blade down the sides of jars to remove air bubbles.
Close	Place marked covers on cans and seal at once.	Wipe tops of jars with clean, damp cloth. Adjust lids.
Process	a. Process in boiling water bath. (212°F.) b. Processing time: #303 — 20 minutes #2 — 20 minutes #2½ — 25 minutes #10 — 40 minutes c. Remove cans from cooker as soon as processing time is completed.	a. Process at once at 212°F. b. Processing time: Pints — 20 minutes Quarts — 25 minutes ½ gallon — 30 minutes
Cool	Cool cans.	Cool jars.

Pears

Select pears
Select firm, ripe fruit.

Prepare cans or glass jars
Use #2, #2½, or #10 cans, or pint, quart or ½ gallon glass jars having self-sealing closures. Wash cans or jars.

Prepare pears
a. Wash with cold water.
b. Peel, quarter, core and cut out defects.
c. Place in mixture made of 2 tablespoons each of salt and vinegar to one gallon of water. This prevents pears from turning dark.
d. Drain off water just before placing fruit in boiling syrup.

Prepare syrup
a. Use moderately light syrup.
b. Approximately 1 cup of syrup will be required for each quart of fruit or #2½ can.

Precook
Precook Keiffer pears 15 to 20 minutes in syrup in steam jacketed kettle. Softer flesh pears should be cooked only until thoroughly heated through.

	Cans	Glass Jars
Fill	Fill cans with hot pears, to within ½ inch of top. Fill to top with hot syrup.	Fill jars with hot pears to within ½ inch of top. Cover with hot syrup leaving ½ inch at top of jar.
Exhaust	Bring center of can temperature to 160°F.	Insert table knife blade down the sides of jars to remove air bubbles.
Close	Place marked covers on cans and seal at once.	Wipe tops of jars with clean, damp cloth. Adjust lids.
Process	a. Process in boiling water bath. (212°F.) b. Processing time: Size — Time #303 — 20 minutes #2 — 30 minutes #2½ — 30 minutes #10 — 40 minutes c. Remove cans from cooker as soon as processing time is completed.	a. Process at once at 212°F. b. Processing time: Size — Time Pints — 30 minutes Quarts — 35 minutes ½ gallon — 40 minutes
Cool	Cool cans.	Cool jars.

Plums

Select plums

Select ripe, firm fruit. Plums that are green will be lacking in flavor and sour. Soft fruit may be used for plum butter.

Prepare cans or glass jars

Use #2, #3, or #10 R-Enamel cans or pint, quart, or ½ gallon glass jars having self-sealing closures. Wash cans or jars.

Prepare plums

a. Wash plums thoroughly, grade for ripeness and discard defective fruit.
b. Prick plums with fork or sharp knife to prevent bursting in processing.
c. Freestone varieties may be halved and pitted.

Prepare syrup

Prepare medium syrup according to syrup chart. Approximately 1 cup of syrup will be required for 1 quart of fruit.

	Cans	Glass Jars
Fill	Fill cans with plums to within ½ inch of top. Fill cans to top with boiling syrup.	Fill jars with plums to within ½ inch of top. Fill jars with boiling syrup to within ½ inch of top.
Exhaust	Bring center of can temperature to 180°F.	Insert table knife blade down the sides of jars to remove air bubbles.
Close	Place marked covers on cans and seal at once.	Wipe tops of jars with clean, damp cloth. Adjust lids.
Process	a. Process in boiling water bath. (212°F.) b. Processing time: #303 — 15 minutes #2 — 15 minutes #2½ — 20 minutes #10 — 25 minutes c. Remove cans from cooker as soon as processing time is completed.	a. Process at once at 212°F. b. Processing time: Pints — 20 minutes Quarts — 25 minutes ½ gallon — 30 minutes
Cool	Cool cans.	Cool jars.

VEGETABLES

Asparagus

Select asparagus
Select fresh, tender stalks

Prepare cans or glass jars
Use #2 cans or pint jars for spears; #2, #2½, or #10 cans may be used or quart jars for cut asparagus. Select jars with self-sealing closures. Wash cans or glass jars.

Prepare asparagus
a. Sort according to size; snap off the tough butts.
b. Wash thoroughly.
c. Tie in uniform bundles of 6 to 8 stalks or cut in 1 inch lengths.

Precook
Steam bundles or cut pieces for 2 to 3 minutes in steam jacketed kettle or steam drop, or cover with boiling water and boil 2 or 3 minutes. Dip in and out of cold water quickly.

	Cans	Glass Jars
Fill	a. Pack hot asparagus in cans to within ½ inch of top. b. Add salt as follows: #2 can - ½ tsp. salt or one 60 grain salt tablet. #2½ can - 1 tsp. salt or two 60 grain salt tablets. #10 can - 3 tsp. salt or six 60 grain salt tablets.	a. Pack hot asparagus in jars to within ½ inch of top. b. Add salt as follows: Pt. jar - ½ tsp. salt or one 60 grain salt tablet. Qt. jar - 1 tsp. salt or two 60 grain salt tablets. c. Fill jar to within ½ inch of top with hot cooking liquid or boiling water.
Exhaust	Bring center of can temperature to 140°F.	Insert table knife blade down the sides of jars to remove air bubbles.
Close	Place marked covers on cans and seal at once.	Wipe top of jar with clean, damp cloth. Adjust lids.
Process	a. Process at 240°F. or 10# pressure. b. Processing time: #2 — 25 minutes #2½ — 25 minutes #10 — 35 minutes #303 — 25 minutes c. Remove cans from cooker as soon as pressure has returned to 0.	a. Process at once at 240°F. or 10# pressure. b. Processing time: Pints — 30 minutes Quarts — 35 minutes
Cool	Cool cans.	Cool jars.

Beans - Butter or Lima

Select beans

Select young, tender beans for canning. Beans should be canned as soon as possible after being gathered.

Prepare cans or glass jars

Use #2, #2½, or #10 C-Enamel or plain cans, or pint or quart glass jars having self-sealing closures. Wash cans or glass jars.

Prepare beans

a. Wash pods in clean water.
b. Discard bad pods.
c. Shell beans and discard imperfect beans.
d. Drop into clean, cold water until ready to pre-cook. Do not put too many beans in one pan.

Precook

If precooking is done in steam jacketed kettle or steam drop, cook smaller beans for 2½ to 3 minutes; more mature beans 4 to 5 minutes; or, cover beans with boiling water and bring to boil.

	Cans	Glass Jars
Fill	a. Pack hot beans in cans to ½ inch of top. b. Add salt as follows: #2 can - ½ tsp. salt or one 60 grain salt tablet. #2½ can - 1 tsp. salt or two 60 grain salt tablets. #10 can - 3 tsp. salt or six 60 grain salt tablets. c. Fill can to top with boiling water.	a. Pack hot beans in jars within 1 inch of top. b. Add salt as follows: Pt. jars - ½ tsp. salt or one 60 grain salt tablet. Qt. jars - 1 tsp. salt or two 60 grain salt tablets. c. Fill jars within one inch of top with boiling water.
Exhaust	Bring center of can temperature to 140 - 160°F.	Insert table knife blade down the sides of jars to remove air bubbles.
Close	Place marked covers on cans and seal at once.	Wipe tops of jars with clean, damp cloth. Adjust lids.
Process	a. Process at once at 240°F. or 10# pressure. b. Processing time: #303 - 35 minutes #2 - 35 minutes #2½ - 40 minutes #10 - 55 minutes c. Remove cans from cooker as soon as pressure has returned to 0.	a. Process at once at 240°F. or 10# pressure. b. Processing time: Pints - 45 minutes Quarts - 50 minutes
Cool	Cool cans.	Cool jars.

Beans - Green Beans (Snap Beans)

Select beans

Select tender beans of good quality.

Prepare cans or glass jars

Use #2, #2½, or #10 C-Enamel or plain cans, or pint or quart jars having self-sealing closures. Wash cans or jars.

Prepare beans

a. Wash thoroughly with cold water, dipping up and down until free from dirt.
b. Be sure that last water is free for all soil.
c. String and sort, cut off ends, and cut or break into short pieces.

Precook

Precook 3 to 5 minutes in steam jacketed kettle or steam drop blanching vat, or cover beans with boiling water and bring to boil. The beans should have a bright green color.

	Cans	Glass Jars
Fill		
	a. Pack hot beans in cans to within ½ inch of top. b. Add salt as follows: #2 can - ½ tsp. salt or one 60 grain salt tablet. #2½ can - 1 tsp. salt or two 60 grain salt tablets. #10 can - 3 tsp. salt or six 60 grain salt tablets. c. Fill cans to top with hot cooking liquid, or boiling water.	a. Pack hot beans in jars to within ½ inch of top. b. Add salt as follows: Pt. jar - ½ tsp. salt or one 60 grain salt tablet. Qt. jar - 1 tsp. salt or two 60 grain salt tablets. c. Fill jars to within ½ inch of top with hot cooking liquid or boiling water.
Exhaust	Bring center of can temperature to 140 - 160°F.	Insert table knife blade down the sides of jars to remove air bubbles.
Close	Place marked covers on cans and seal at once.	Wipe top of jars with clean, damp cloth. Adjust lids.
Process	a. Process at once at 240°F. or 10# pressure. b. Processing time: #2 — 20 minutes #2½ — 25 minutes #10 — 35 minutes #303 — 20 minutes c. Remove cans from cooker as soon as pressure has returned to 0.	a. Process at once at 240°F. or 10# pressure. b. Processing time: Pints — 25 minutes Quarts — 30 minutes
Cool	Cool cans.	Cool jars.

Beets

Select beets

Select young, tender beets. Beets should be canned soon after harvesting to preserve color, flavor and texture.

Prepare cans or glass jars

Use #2, #2½, or #10 R-Enamel cans or pint or quart glass jars having self-sealing closures. Wash cans or jars.

Prepare beets

a. Wash beets in cold water.
b. Cut off tops leaving 1 inch of stem; if tender the tops may be canned. Leave roots to prevent bleeding.

Precook

a. Steam beets for 15 to 20 minutes, or cover with boiling water and boil until skins slip easily.
b. Put in cold water until cool enough to handle; remove skins and trim.
c. Small beets may be packed whole.
d. Beets may be cut in halves, quarters, slices, or diced as preferred.

	Cans	Glass Jars
Fill	a. Pack hot beets to within ½ inch of top. b. Add salt as follows: #2 can - ½ tsp. salt or one 60 grain salt tablet. #2½ can - 1 tsp. salt or two 60 grain salt tablets. #10 can - 3 tsp. salt or six 60 grain salt tablets. c. Fill cans to top with boiling water.	a. Pack hot beets to within ½ inch of top. b. Add salt as follows: Pt. jars - ½ tsp. salt or one 60 grain salt tablet. Qt. jars - 1 tsp. salt or two 60 grain salt tablets. c. Fill jars to within ½ inch of top with boiling water.
Exhaust	Bring center of can temperature to 160°F.	Insert table knife blade down the sides of jars to remove air bubbles.
Close	Place marked covers on cans and seal at once.	Wipe tops of jars with a clean, damp cloth. Adjust lids.
Process	a. Process at 240°F. or 10# pressure. b. Processing time: #303 - 30 minutes #2 - 30 minutes #2½ - 35 minutes #10 - 45 minutes c. Remove cans from cooker as soon as pressure has reached 0.	a. Process at 240°F. or 10# pressure. b. Processing time: Pints - 30 minutes Quarts - 35 minutes
Cool	Cool cans.	Cool jars.

Carrots

Select carrots

Select young, tender carrots. Carrots should be canned soon after harvesting to preserve color, flavor and texture.

Prepare cans or glass jars

Use #2, #2½, or #10 cans or pint or quart size glass jars having self-sealing closures. Wash cans or jars.

Prepare carrots

a. Cut tops off close to the head of carrots.
b. Wash well in several waters.
c. Using brush and knife, scrape or peel to remove skin.
d. Carrots may be packed whole or cut into circles or strips according to preference.

Precook

Steam carrots for 10 to 15 minutes or cover with boiling water and boil for 5 minutes.

	Cans	Glass Jars
Fill		
	a. Pack hot carrots to ½ inch of top. b. Add salt as follows: #2 can - ½ tsp. salt or one 60 grain salt tablet. #2½ can - 1 tsp. salt or two 60 grain salt tablets. #10 can - 3 tsp. salt or six 60 grain salt tablets. c. Fill cans to top with hot cooking liquid or boiling water.	a. Pack hot carrots to ½ inch of top. b. Add salt as follows: Pt. jars - ½ tsp. salt or one 60 grain salt tablet. Qt. jars - 1 tsp. salt or two 60 grain salt tablets. c. Fill jars with cooking liquid or boiling water to within ½ inch of top.
Exhaust	Bring center of can temperature to 160°F.	Insert table knife blade down sides of jars to remove air bubbles.
Close	Place marked covers on cans and seal at once.	Wipe tops of glass jars with clean damp cloth. Adjust lids.
Process	a. Process at 240°F., or 10# pressure. b. Processing time: #303 — 30 minutes #2 — 30 minutes #2½ — 30 minutes #10 — 45 minutes c. Remove cans from cooker as soon as pressure has reached 0.	a. Process at 240°F. or 10# pressure. b. Processing time: Pints — 30 minutes Quarts — 35 minutes
Cool	Cool cans.	Cool jars.

Corn - Cream Style

Select corn

Use only tender corn in the milk stage. Corn should be in the can cooking as early as possible after taking from the stalk. Gather in early morning and process as quickly as possible. If corn must be held, keep in a cool airy place. Only as much as can be prepared and put into the cooker within 2 hours from stalk to cooker is a good rule.

Prepare cans or glass jars

Use #2 or #303 C-Enamel cans, or pint size glass jars, having self-sealing closures. Cream style corn should not be canned in containers larger than pint jars or #2 cans. Wash cans or jars.

Prepare and precook corn

a. Remove shucks from the corn.
b. Silk with a clean brush.
c. Cut away any damaged parts.
d. Wash in cold water.
e. Using a sharp knife, lightly cut off the tops of the kernels and with the back of the knife, scrape out the pulp.
f. Measure corn. Add half as much boiling water as corn.
g. Heat corn and water to 190° to 200°F. in steam jacketed kettle, or heat just to boiling temperature. Do not boil.

	Cans	Glass Jars
Fill		
	a. Fill cans to top with boiling hot corn. b. Add ½ tsp. salt or one 60 grain salt tablet.	a. Fill jars to within 1 inch of top with boiling hot corn. b. Add ½ tsp. salt or one 60 grain salt tablet.
Exhaust	Bring center of can temperature to 185°F.	Insert table knife blade down sides of jars to remove air bubbles.
Close	Place marked covers on cans and seal at once.	Wipe tops of jars with clean, damp cloth. Adjust lids.
Process	a. Process at 240°F. or 10# pressure. b. Processing time: Size — Time #303 — 90 minutes #2 — 90 minutes c. Remove cans from cooker as soon as pressure has reached 0.	a. Process at 240°F. or 10# pressure. b. Processing time: Size — Time Pints — 90 minutes
Cool	Cool cans.	Cool jars.

Corn - Whole Grain

Select corn

Select young, tender corn. Gather in early morning and process as quickly as possible. If corn must be held, keep in a cool, well-ventilated place. It is a good idea to process within two hours after harvesting.

Prepare cans or glass jars

Use #2 or #2½ C-Enamel cans; or, pint or quart glass jars having self-sealing closures. Wash cans or jars.

Prepare corn

a. Remove shucks and as much of silk as possible. Place ears in cold water.
b. Remove silk with clean brush.
c. Wash ears in clean cold water. Grade for maturity as removing from water.
d. Cut corn from cob at about two-thirds depth of kernel. Do not scrape.

Precook

To each quart of cut corn, add 1 pint of boiling water. Heat to boiling or 212°F.

	Cans	Glass Jars
Fill	a. Pack hot corn to ½ inch from top and fill to top with hot cooking liquid. b. Add ½ tsp. salt or one 60 grain salt tablet.	a. Pack hot corn to 1 inch from top and fill with cooking liquid to within 1 inch from top. b. Add ½ tsp. salt or one 60 grain salt tablet for pints, or two 60 grain salt tablets for quarts.
Exhaust	Bring center of can temperature to 185°F.	Insert table knife blade down sides of jars to remove air bubbles.
Close	Place marked covers on cans and seal at once.	Wipe tops of jars with clean, damp cloth. Adjust lids.
Process	a. Process at once at 240°F. or 10# pressure. b. Processing time: #303 — 50 minutes #2 — 50 minutes #2½ — 70 minutes b. Remove cans from cooker as soon as pressure has reached 0.	a. Process at once at 240°F. or 10# pressure. b. Processing time: Pints — 60 minutes Quarts — 70 minutes
Cool	Cool cans.	Cool jars.

Greens

Select greens
Can only tender greens, freshly picked.

Prepare cans or glass jars
Use #2 or #2½ cans or pint or quart size jars having self-sealing closures. Wash cans or jars.

Prepare greens
a. Pick over carefully; remove tough stems and bad leaves.
b. Wash several times with cold water, lifting up and down in water from one container to another to prevent dirt from getting back onto leaves.

Precook
Put into a small amount of boiling water or steam, and boil or steam until leaves are wilted.

	Cans	Glass Jars
Fill		
	a. Pack hot greens loosely to within ½ inch of top. Cut through greens with long sharp knife to allow circulation of liquid. b. Add salt as follows: #2 or #2½ - add ½ tsp. salt or one 60 grain salt tablet. c. Fill cans to top with boiling water.	a. Pack hot greens loosely to within ½ inch of top. Cut through greens with long sharp knife to allow circulation of liquid. b. Add salt as follows: Pints - ½ tsp. salt or one 60 grain salt tablet. Quarts - 1 tsp. salt or two 60 grain salt tablets. c. Fill jars to within ½ inch of top with boiling water.
Exhaust	Bring center of can temperature to 150 - 160°F.	Insert table knife blade down the sides of jars to remove air bubbles.
Close	Place marked covers on cans and seal at once.	Wipe top of jar with clean, damp cloth. Adjust lids.
Process	a. Process at once at 240°F. or 10# pressure. b. Processing time: #303 - 60 minutes #2 - 60 minutes #2½ - 75 minutes c. Remove cans from cooker as soon as pressure has returned to 0.	a. Process at once at 240°F. or 10# pressure. b. Processing time: Pints - 85 minutes Quarts - 105 minutes
Cool	Cool cans.	Cool jars.

VEGETABLES — Peas - Green (English) and Black Eyed

Select peas
Select young, tender peas

Prepare cans or glass jars
Use #2 or #2½ cans or pint or quart glass jars with self-sealing closures. Wash cans or jars.

Prepare peas
a. Wash pods thoroughly, discarding bad ones.
b. Shell peas, discarding faulty ones. Grade peas for size and maturity.
c. Drop into shallow pans, holding cold water.

Precook
Cover with boiling water and simmer 5 minutes at 190°F; or precook under steam drop from 3 to 5 minutes; or, cover with boiling water and bring to boil.

	Cans	Glass Jars
Fill	a. Pack hot peas in can to within ½ inch of top. b. Add salt as follows: #2 can - ½ tsp. salt or one 60 grain salt tablet. #2½ can - 1 tsp. salt or two 60 grain salt tablets. c. Fill to top of can with boiling water.	a. Pack hot peas in jars to within 1 inch of top. b. Add salt as follows: Pt. jar - ½ tsp. salt or one 60 grain salt tablet. Qt. jar - 1 tsp. salt or two 60 grain salt tablets. c. Fill jars to within one inch of top with boiling water.
Exhaust	Bring center of can temperature to 140°F.	Insert table knife blade down sides of jars to remove air bubbles.
Close	Place marked covers on cans and seal at once.	Wipe top of jars with clean, damp cloth. Adjust lids.
Process	a. Process at 240°F. or 10# pressure. b. Processing time: Size — Time #303 — 35 minutes #2 — 35 minutes #2½ — 40 minutes c. Remove cans from cooker as soon as pressure has returned to 0.	a. Process at 240°F. or 10# pressure. b. Processing time: Size — Time Pints — 40 minutes Quarts — 45 minutes
Cool	Cool cans.	Cool jars.

Pumpkin and Winter Squash

Select squash or pumpkin

Select firm, fully ripened squash or pumpkin of good texture and color, not frosted.

Prepare cans or glass jars

Use #2 or #2½ R-Enamel tin cans or pint or quart glass jars having self-sealing closures. Wash cans or jars.

Prepare pumpkin or squash

a. Wash with cold water.
b. Cut off stem and blossom ends.
c. Cut open, remove seeds and spongy pulp; remove rind by peeling.
d. Cut in small pieces about ½ inch square.

Precook

a. Add a small amount of water. Steam or boil until tender, stirring occasionally. Allow steam to escape for last few minutes of cooking so product will not be watery.
b. Put through a sieve or colander.

	Cans	Glass Jars
Fill	a. Fill can to within ¼ inch of top with hot pumpkin or squash. b. Add salt as follows: #2 can - ½ tsp. salt or one 60 grain salt tablet. #2½ can - 1 tsp. salt or two 60 grain salt tablets. c. Fill cans to top with cooking liquid or boiling water.	a. Fill jars to within ½ inch of top with hot pumpkin or squash. b. Add salt as follows: Pt. jar - ½ tsp. salt or one 60 grain salt tablet. Qt. jar - 1 tsp. salt or two 60 grain salt tablets. c. Fill jars to within ½ inch of top with cooking liquid or boiling water.
Exhaust	Bring center of can temperature to 180°F.	Insert table knife blade down sides of jars to remove air bubbles.
Close	Place marked covers on cans and seal at once.	Wipe top of jars with clean, damp cloth. Adjust lids.
Process	a. Process at 240°F. or 10# pressure. b. Processing time: Size — Time #303 — 75 minutes #2 — 85 minutes #2½ — 115 minutes c. Remove cans from cooker as soon as pressure has returned to 0.	a. Process at 240°F. or 10# pressure. b. Processing time: Size — Time Pints — 85 minutes Quarts — 130 minutes
Cool	Cool cans.	Cool jars.

Rhubarb

Select rhubarb
Select young tender stalks.

Prepare cans or glass jars
Use #2 or #2½ cans, or pint or quart glass jars, having self-sealing closures. Wash cans or jars.

Prepare rhubarb
a. Trim off leaves.
b. Wash stalks thoroughly in cold water.
c. Cut into half inch lengths.
d. Add ½ cup sugar to each quart rhubarb and let stand long enough to draw out juice. Bring to boil.

	Cans	Glass Jars
Fill	a. Fill can to ½ inch of top with hot rhubarb. b. Add boiling syrup to top of can.	a. Fill jars to within ½ inch of top with hot rhubarb. b. Add boiling syrup covering rhubarb and leaving ½ inch space from top.
Exhaust	Bring center of can temperature to 140°F.	Insert table knife blade down the sides of jars to remove air bubbles.
Close	Place marked covers on cans and seal at once.	Wipe top of jars with clean, damp cloth. Adjust lids.
Process	a. Process in boiling water bath (212°F.). b. Processing time: Size — Time #2 — 10 minutes #2½ — 10 minutes #303 — 10 minutes c. Remove cans from cooker as soon as processing time is completed.	a. Process at once at 212°F. b. Processing time: Spray cooled: Size — Time Pint — 10 minutes Quart — 10 minutes Air cooled: Reduce above time by 5 minutes.
Cool	Cool cans.	Cool jars.

Sauerkraut

Select cabbage

Select hard, sound heads of cabbage.

Prepare cans or glass jars

Use #2, #2½, or #10 R-Enamel cans or pint, quart or ½ gallon glass jars having self-sealing closures. Wash cans or jars.

Prepare cabbage

a. Trim off outside leaves.
b. Quarter the heads and remove core.
c. Finely shred the cabbage, using a sharp knife, or a kraut cutter.

Pack

a. Pack into water-tight containers (earthenware crocks, wooden kegs, or barrels are most commonly used).
b. Make alternate layers of cabbage and salt, using 2 ounces (¼ cup) salt to 5 pounds cabbage or 1 pound salt to 40 pounds cabbage.
c. Set aside until fermentation is complete and bubbles cease to rise (about 10 days). (Should be kept at about 65 - 70°F.)
d. Keep scum cleaned off top of brine. (Sauerkraut should be well fermented before it is canned.)

Skim and heat

a. Remove scum completely from top of containers.
b. Heat the sauerkraut in its own juice, to simmering (about 160°F.) but avoid boiling.

	Cans	Glass Jars
Fill	Pack kraut firmly into cans, to within ½ inch of top. Fill cans with hot kraut juice.	Pack kraut firmly into jars to within ½ inch of top. Fill jars with hot kraut juice to within ½ inch of top.
Exhaust	Bring center of can temperature to 160°F.	Insert table knife blade down the sides of jars to remove air bubbles.
Close	Place marked covers on cans and seal at once.	Wipe tops of jars with clean, damp cloth. Adjust lids.
Process	a. Process in boiling water bath. (212°F.) b. Processing time: #303 — 15 minutes #2 — 15 minutes #2½ — 20 minutes #10 — 30 minutes c. Remove cans from cooker as soon as processing time is completed.	a. Process at once at 212°F. b. Processing time: Spray cooled: Pints — 20 minutes Quarts — 25 minutes ½ gallon — 30 minutes Air cooled: Reduce above time by 5 minutes.
Cool	Cool cans.	Cool jars.

Summer Squash

Select squash
Select only young tender squash.

Prepare cans or glass jars
Use #2 or #2½ plain tin cans, or pint or quart glass jars with self-sealing closures. Wash cans or jars.

Prepare squash
a. Wash thoroughly in cold water.
b. Cut off stems and blossom ends.
c. Cut into 1/2 to 3/4 inch slices, halves, or quarters.

Precook
Precook in just enough water to cover. Bring to boiling point.

	Cans	Glass Jars
Fill		
	a. Pack hot squash in cans to within ½ inch of top.	a. Pack hot squash in jars to within ½ inch of top.
	b. Add salt as follows: #2 can - ½ tsp. salt or one 60 grain salt tablet. #2½ can - 1 tsp. salt or two 60 grain salt tablets.	b. Add salt as follows: Pt. jars - ½ tsp. salt or one 60 grain salt tablet. Qt. jars - 1 tsp. salt or two 60 grain salt tablets.
	c. Fill cans to top with hot cooking liquid.	c. Fill jars to within ½ inch of top with hot cooking liquid.
Exhaust	Bring center of can temperature to 160°F.	Insert table knife blade down sides of jars to remove air bubbles.
Close	Place marked covers on cans and seal at once.	Wipe tops of jars with clean, damp cloth. Adjust lids.
Process	a. Process at 240°F. or 10# pressure.	a. Process at 240°F. or 10# pressure.
	b. Processing time: Size — Time #303 — 40 minutes #2 — 40 minutes #2½ — 50 minutes	b. Processing time: Size — Time Pints — 45 minutes Quarts — 55 minutes
	c. Remove cans from cooker as soon as pressures has returned to 0.	
Cool	Cool cans.	Cool jars.

Sweet Potatoes - Wet Pack (In Syrup)

Select sweet potatoes
Select freshly dug sound potatoes.

Prepare cans or glass jars
Use #2 or #2½ cans or pint or quart glass jars having self-sealing closures. Wash cans or jars.

Prepare sweet potatoes
a. Wash thoroughly, scrubbing with a vegetable brush.
b. Remove any bad spots and discard potatoes with unpleasant odor.

Precook and peel
a. Steam at 240°F., 10 to 15 minutes, or boil until skins slip easily.
b. Peel quickly.

Prepare syrup
If syrup is used, prepare a light syrup.

	Cans	Glass Jars
Fill		
	a. Pack hot sweet potatoes in cans to ½ inch of top. b. Fill can to top with boiling syrup or boiling water. If boiling water is used, add salt as follows: #2 can - ½ tsp. salt or one 60 grain salt tablet. #2½ can - 1 tsp. salt or two 60 grain salt tablets.	a. Pack hot sweet potatoes in jars to within 1 inch of top. b. Fill jar to within 1 inch of top with boiling syrup or boiling water. If boiling water is used, add salt as follows: Pt. jars - ½ tsp. salt or one 60 grain salt tablet. Qt. jars - 1 tsp. salt or two 60 grain salt tablets.
Exhaust	Bring center of can temperature to 175°F.	Insert table knife blade down sides of jars to remove air bubbles.
Close	Place marked covers on cans and seal at once.	Wipe tops of jars with clean, damp cloth. Adjust lids.
Process	a. Process at 240°F., or 10# pressure. b. Processing time: Size — Time #303 — 60 minutes #2 — 60 minutes #2½ — 65 minutes c. Remove cans from cooker as soon as pressure has returned to 0.	a. Process at 240°F., or 10# pressure. b. Processing time: Size — Time Pints — 60 minutes Quarts — 65 minutes
Cool	Cool cans.	Cool jars.

VEGETABLES

Tomatoes (Raw Pack Method)

Select tomatoes

Select firm, red ripe tomatoes.

Prepare cans or glass jars

Use #2, #2½, or #10 cans, or pint, quart or ½ gallon glass jars having self-sealing closures. Wash cans or jars.

Prepare tomatoes

a. Wash with cold water.
b. Scald in boiling water 1 to 2 minutes.
c. Dip in cold water to crack the skins.
d. Remove skin and core tomatoes.
e. Cut out all of core and hard sections of tomatoes. Avoid using any tomato having a sour odor.

	Cans	Glass Jars
Fill		
	a. Pack raw tomatoes, leaving small or medium sized ones whole. Large tomatoes may be halved or quartered. Press tomatoes gently to fill spaces in can. Fill cans to top with tomatoes. b. Add salt as follows: #2 can - ½ tsp. salt or one 60 grain salt tablet. #2½ can - 1 tsp. salt or two 60 grain salt tablets. #10 can - 3 tsp. salt or six 60 grain salt tablets.	a. Pack raw tomatoes, leaving small or medium sized ones whole. Large tomatoes may be halved or quartered. Press tomatoes gently to fill spaces in jar. Fill jars to within ½ inch of the top. b. Add salt as follows: Pt. jars - ½ tsp. salt or one 60 grain salt tablet. Qt. jars - 1 tsp. salt or two 60 grain salt tablets. ½ gallon - 2 tsp. salt or four 60 grain salt tablets.
Exhaust	Bring center of can temperature to 140°F.	Insert table knife blade down the sides of jars to remove air bubbles.
Close	Place marked covers on cans and seal at once.	Wipe tops of jars with clean, damp cloth. Adjust lids.
Process	a. Process in boiling water bath (212°F.) b. Processing time: Size — Time #2 — 45 minutes #2½ — 55 minutes #10 — 90 minutes #303 — 40 minutes c. Remove cans from cooker as soon as processing time is completed.	a. Process at once at 212°F. b. Processing time: Spray cooled: Size — Time Pints — 45 minutes Quarts — 55 minutes ½ gallon — 65 minutes Air cooled: Reduce above time by 10 minutes.
Cool	Cool cans.	Cool jars.

Tomato Juice

It is a good idea to work with quantities of no more than 2 gallons of tomatoes at a time. This is to speed up the process and save as much of the Vitamin C content as possible.

Select tomatoes
Use only freshly picked, fully red ripe, firm tomatoes.

Prepare cans or 2½ glass jars
Use #2, #2½, or #10 cans or pint, quart, or ½ gallon glass jars having self-sealing closures. Wash cans or jars.

Prepare tomatoes
a. Wash thoroughly.
b. Remove stem ends and quarter tomatoes. Cut out any green sections.

Precook and strain
a. Simmer tomatoes until heated through and softened (about 3 minutes); stir to prevent sticking.
b. Put through a sieve.
c. Add 1 teaspoon of salt for each quart of juice.
d. Reheat juice at once, juice boiling.

	Cans	Glass Jars
Fill	Fill cans to top with hot juice.	Fill glass jars to within ½ inch of top with hot juice.
Exhaust	Bring center of can temperature to 190°F.	
Close	Place marked covers on cans and seal at once.	Wipe tops of jars with clean, damp, cloth. Adjust lids.
Process	a. Process in boiling water bath (212°F.). b. Processing time: #303 — 10 minutes #2 — 10 minutes #2½ — 15 minutes #10 — 30 minutes	a. Process at once at 212°F. b. Processing time: Spray cooled: Pints — 15 minutes Quarts — 15 minutes ½ gallon — 25 minutes Air cooled: Reduce above time by 5 minutes.
Cool	Cool cans.	Cool jars.

Vegetables (Mixed)

Select foods to combine

The combination of foods to use may include two or more of the following: tomatoes, lima beans, okra, corn, carrots, green or red peppers. A mixture may contain one-third tomato and two-thirds other vegetables.

Prepare cans or glass jars

Use #2 or #2½ cans, or pint or quart glass jars having self-sealing closures. Wash cans or jars.

Prepare vegetable mixture

a. Wash vegetables.
b. Prepare each vegetable as for canning alone.
c. Mix vegetables.

Precook

a. Add small amount of water to mixture to prevent sticking.
b. Bring to boiling point and cook 10 minutes, stirring frequently.

Fill

Cans

a. Fill cans to within ½ inch of top with vegetables.
b. Add seasoning as follows:

Size	Salt	Sugar
#2	½ tsp.	½ tsp.
#2½	½ tsp.	½ tsp.

c. Fill to top of can with cooking liquid.

Glass Jars

a. Fill jars to within ½ inch of top with vegetables.
b. Add seasoning as follows:

Size	Salt	Sugar
Pints	½ tsp.	½ tsp.
Quarts	1 tsp.	1 tsp.

c. Fill jars to within ½ inch of top with cooking liquid.

Exhaust

Bring center of can temperature to 150°F.

Insert knife blade down sides of jars to remove air bubbles.

Close

Place marked covers on cans and seal at once.

Wipe off tops of jars with clean, damp cloth. Adjust lids.

Process

a. Process at 240°F. or 10# pressure.
b. Processing time:

Size	Time
#303	35 minutes
#2	35 minutes
#2½	45 minutes

c. Remove cans from cooker as soon as pressure has returned to 0.

a. Process at 240°F. or 10# pressure.
b. Processing time:

Size	Time
Pints	45 minutes
Quarts	50 minutes

Cool

Cool cans.

Cool jars.

Chicken

Prepare

a. Prepare chicken as preferred for serving. Bony pieces of chicken may be used in making broth. It should be made as soon as possible in order to have it ready when needed in filling cans or jars. Broth may be made as follows:
   Place bony pieces in container and cover with cold water.
   Place container in exhaust box and simmer until meat is tender.
   Drain broth into bowl; skim off fat.
   Meat stripped from bone may be canned.
b. Prepare cans or glass jars.

Cans

Fill

a. Fill cans to top with firmly packed raw chicken as follows: Pack second joints and drumsticks with skin next to can, breasts in center of can, smaller pieces fitted in.
b. Add salt as follows:
   #2 can - ½ tsp. salt
   #2½ can - 1 tsp. salt

Precook and Exhaust

Precook 20 to 25 minutes at 10# pressure. When pressure gauge shows 0, remove cans. Fill cans with hot broth if liquid is not already to this point. Check center of can temperature. If not 170°F., reheat.

Close

Place marked covers on cans and seal at once.

Process

a. Process at once at 240°F.
b. Processing time:

Size	Time
#303	75 minutes
#2	75 minutes
#2½	100 minutes

c. Remove cans from cooker as soon as pressure has returned to 0.

Cool

Cool cans.

Glass Jars

a. Fill jars to within 1 inch of top with firmly packed raw chicken as follows: Pack second joints and drumstick with skin next to glass, breasts in center of jar and smaller pieces fitted in.
b. Add salt as follows:
   Pint jars - ½ tsp. salt
   Quart jars - 1 tsp. salt

Precook 20 to 25 minutes at 10# pressure. When pressure gauge shows 0, remove jars. Fill jars to within 1 inch of top with hot broth if liquid is not already to this point. Insert table knife blade down the sides of jars to remove air bubbles.

Wipe tops of jars with clean, damp cloth. Adjust lids.

a. Process at once in pressure cooker at 240°F.
b. Processing time:

Size	Time
Pints	80 minutes
Quarts	90 minutes

Cool jars.

Chicken Giblets

Prepare giblets

When dressing fowl, clean and wash gizzards and hearts. Remove gall bladder from livers, being careful not to break the gall. Can the livers separately as they have a distinct flavor, they also will discolor other giblets or meat.

Prepare cans or glass jars

Use #2 or #2½ cans, or pint or quart glass jars having self-sealing closures. Wash cans or jars.

Cans	Glass Jars
Fill Pack giblets into cans to top of can. Add ½ tsp. salt for #2 cans. Add 1 tsp. salt for #2½ cans.	Pack giblets into jars to within ½ inch of top of jar. Add ½ tsp. salt for pint jars. Add 1 tsp. salt for quart jars.
Precook and exhaust Precook for 25 minutes at 10# pressure. a. When pressure gauge shows 0, remove cans. b. Fill cans with hot broth if liquid is not already to this point. c. Check center of can temperature; if not 170°F., reheat.	Precook for 25 minutes at 10# pressure. a. When pressure gauge shows 0, remove jars. b. Fill jars to within one inch of top with hot broth if liquid is not already to this point. c. Insert blade of table knife down sides of jars to remove air bubbles.
Close Place marked covers on cans and seal at once.	Wipe off tops of jars with clean, damp cloth. Adjust lids.
Process a. Process at once at 240°F. b. Processing time: #303 — 75 minutes #2 — 75 minutes #2½ — 100 minutes c. Remove cans from cooker as soon as pressure has returned to 0.	a. Process at once at 240°F. b. Processing time: Pints — 75 minutes Quarts — 105 minutes
Cool Cool cans.	Cool jars.

Select meat for hamburger

Beef is usually preferred for meat cakes. Meat trimmings and cuts, such as the meat from the neck, fore shoulder, or round, may be used.

Prepare meat

To 25 pounds of fresh beef and/or beef trimmings, add 2/3 cup salt. Omit onion of other seasonings as they develop undesirable flavors. Spread the salt evenly over the meat and put through food grinder twice using coarse plate first and finer plate for second grinding.

Prepare cans or glass jars

Size of cans or jars:
For meat cakes, use #2 or #2½ cans; or pint or quart glass jars.
For solid pack, use #2 or #2½ cans.
If glass jars are to be used, the wide-mouth type will permit easier packing and removal of meat cakes from the jar. Wash cans or jars.

	Cans	Glass Jars
Fill	Fill cans to top with hamburger: a. Hamburger may be packed solid and rounded over top to 1" height. b. Meat may be made into cakes and packed into cans.	Fill jars to top with hamburger: a. Hamburger should be made into cakes before packing, as solid pack is not recommended for glass jars.
Precook and exhaust	a. Exhaust in retort for 25 minutes at 10# pressure, or 240°F. When retort is at 0, remove cans working rapidly to secure closing as quickly as possible. Add hot broth to fill cans. b. Check center of can temperature. It should be 170°F. or higher; if necessary, reheat.	a. Exhaust in retort for 25 minutes at 10# pressures or 240°F. When retort is at 0, remove jars, working rapidly to secure closing as quickly as possible.
Close	Place marked covers on cans and seal at once.	Wipe tops of jars with clean, damp cloth. Adjust lids.
Process	a. Process in pressure cooker at 240°F. b. Processing time: Size / Solid Pack / Cakes #2 / 100 minutes / 65 minutes #2½ / 135 minutes / 90 minutes c. Remove cans from cooker as soon as pressure has returned to 0.	a. Process in pressure cooker at 240°F. b. Processing time: Size / Cakes Pints / 90 minutes Quarts / 105 minutes
Cool	Cool cans.	Cool jars.

Headcheese

Prepare

Headcheese is made from the hog's head, and organs such as heart and tongue. Pieces of pork trimmings may be added.

Clean hog's head by removing snout, eyes, ears, brain, and all skin. Trim off all fat. Cut head in four pieces and soak in salt water (½ cup salt to 1 gallon water), for 3 to 5 hours to draw out all blood. Drain from salt solution and wash well in clear water.

Cover pieces of meat that are to be used with water and simmer until meat is tender and slips easily from bones. Save the cooking liquid; liquid may be boiled until it has evaporated to quantity of broth needed. Remove all meat from bones and chop fine or grind the meat through a coarse plate. Weigh the meat. To each 6 pounds of meat, add the following:

3 tablespoons salt
4 teaspoons pepper
2 quarts broth in which meat is boiled.

Mix well and bring mixture to a boil

Prepare cans or glass jars

Use only #2 plain cans or wide-mouth pint glass jars, with self-sealing closures. Wash cans or jars.

	Cans	Glass Jars
Fill	Fill cans to top with hot headcheese.	Fill jars to within ½ inch of top with hot headcheese.
Exhaust	Bring center of can temperature to 170°F.	Insert blade of table knife down the sides of jars to remove air bubbles.
Close	Place marked covers on cans and seal at once.	Wipe tops of jars with clean, damp cloth. Adjust lids.
Process	a. Process at once at 240°F. b. Processing time: Size: #2 — Time: 100 minutes c. Remove cans from cooker as soon as pressure has returned to 0.	a. Process at once at 240°F. b. Processing time: Size: Pints — Time: 125 minutes
Cool	Cool cans.	Cool jars.

Yield

The following yield of rendered lard may be expected:

Leaf fat (layer of fat around kidney of hog) - 90-93% of its weight.
Combination of leaf fat, back fat, and cutting fat - 80-85% of its weight.
Ruffle fat (fat covering intestines) - 50-65% of its weight.

Select fat

a. For white, creamy, high quality lard, the fat should be trimmed and rendered as soon as possible after the carcass is thoroughly chilled.
b. Ruffle fats yield a darker, less desirable product and should be rendered separately.

Prepare cans or glass jars

Use #303, #2, #2½ or #10 cans or pint or quart glass jars having self-sealing closures. Wash cans or jars.

Prepare

Cut fat in thin strips or run thrcugh a meat chopper.

Cook

a. Put a small amount of water in steam jacketed kettle. Add pieces of fat.
b. Apply steam and cook slowly, stirring frequently until lard has reached a temperature of 250°F. When cracklings begin to settle to the bottom of the cooker, greater care should be taken to prevent scorching. The more nearly complete, rendering removes a greater proportion of the moisture, producing lard that will be more likely to keep.
c. Allow lard to settle and cool slightly before removing from the kettle.

Fill containers and store

a. Fill lard into cans or jars while hot.
b. Store permanently in a cool, dark place.

Seal cans or jars

No processing is necessary.

Cool lard

To produce a fine grain lard, chill immediately.

Store lard

Store cans or jars of lard in a cool, dark place.

Note

Canning meat and meat products requires careful attention to sanitation practices. Several important practices are listed below.

(1) Micro-organisms grow faster at higher storage temperatures. (Do not keep fresh meat above 50°F. for more than 4 hours.)
(2) Micro-organisms grow faster on moist, wet surfaces.
(3) Keep equipment which comes into contact with meat clean. (Cleaning should be done immediately after use of equipment.)
(4) Water used in cleaning should be 140°F., or higher.
(5) Persons handling meat should have clean hands and clothing. (Fingernails should be trimmed.)

Pork Sausage

Select meat

Sound, high quality pork meat should be used. In addition to meat trimmings, pork cuts, such as the shoulder, are sometimes made into sausages.

Prepare sausage

The proportion of two-thirds lean meat and one-third fat will produce a product which will brown easily without too great cooking loss. To 25 pounds of fresh pork and/or pork trimmings, add:

- 2/3 cup salt
- 1/2 ounce ground pepper
- Omit sage as processing develops a bitter flavor.

Mix seasonings and spread evenly over meat and grind through a fine plate. Grinding may be done through a coarse plate first and then through a fine one.

Prepare cans or glass jars

Wash cans or jars; wide-mouth jars are preferred. Size of cans or jars: Sausage cakes, use #2 or #2½ tin cans; or pint or quart glass jars. Solid pack, use #2 or #2½ tin cans.

	Cans	Glass Jars
Fill	Fill cans to top with sausage: a. Sausage may be packed solid and rounded over top to 1 inch height. b. Sausage may be made into cakes and packed into cans.	Fill jars to top with sausage: a. Sausage should be made into cakes before packing, as solid pack is not recommended for glass jars.
Precook and exhaust	Exhaust cans in exhaust box until center temperature of cans reaches 170°F.	Exhaust jars in exhaust box until center temperature of jars reaches 170°F.
Close	Place marked covers on cans and seal at once.	Adjust lids on jars.
Process	a. Process at 240°F. b. Processing time: Size / Solid Pack / Cakes #2 / 100 minutes / 65 minutes #2½ / 135 minutes / 90 minutes c. Remove cans as soon as pressure has returned to 0.	a. Process at 240°F. b. Processing time: Size / Cakes Pints / 90 minutes Quarts / 135 minutes
Cool	Cool cans.	Cool jars.

Prepare

Cut meat into canning portions. Cut tender pieces into roasts, steaks, or chops, and less tender portions into stew meat.

Roasts

Solid - cut meat in solid pieces to fit the diameter of the can or jar, with the grain of the meat running lengthwise.
For cans - cut to fit ½ inch above level of top of can.
For jars - cut to fit level with top of jar.

Rolled flank - roll flank or brisket to fit diameter of the can or jar, tie and cut to fit correct length of can or jar.
For cans - cut to fit level with top of can.
For jars - cut to fit ½ inch below level of top of jar.

Steaks and chops

Cut across the grain approximately 1 inch thick. Cut sliced pieces to fit the diameter of the can or jar.

Stew meats

Cut in approximately 1 inch squares.

Prepare cans or glass jars

Use #2 or #2½ cans or wide-mouth pint glass jars, according to quantity for serving meals, with self-sealing closures.

Precook and exhaust

a. Precook meat in a steam jacketed kettle, with just enough water to partially cover the meat, until slightly pink in the center.
b. Fill cans or jars with the precooked meat and add salt (as shown below) and enough hot broth to cover meat and leave 3/8 inch headspace.
c. Exhaust to a center temperature of 170°F.
d. Use salt as follows:

Cans		Glass Jars	
#303 can	½ tsp. salt	pint jars	½ tsp. salt
#2 can	½ tsp. salt	quart jars	1 tsp. salt
#2½ can	1 tsp. salt		

Close

Cans

a. Place marked covers on cans and seal at once.
b. Wipe cans clean to keep grease out of retort.

Glass Jars

a. Wipe tops of jars with clean, damp cloth. Adjust lids.
b. Wipe jars clean to keep grease out of retort.

Process

a. Place cans in basket as quickly as possible. When basket is partially filled, it may be placed in retort with small amount of steam to hold the temperature of cans. Add cans as they are sealed.
b. Process at once at 240°F.
c. Processing time:

Size	Time
#303	75 minutes
#2	75 minutes
#2½	100 minutes

d. Remove cans from cooker as soon as pressure has returned to 0.

a. Place jars in basket as quickly as possible. When basket is partially filled, it may be placed in retort with small amount of steam to hold the temperature of jars. Add jars as quickly as lids can be adjusted.
b. Process at once at 240°F.
c. Processing time:

Size	Time
Pints	75 minutes
Quarts	105 minutes

Cool

Cool cans.

Cool jars.

Broth and Soup Stock (Beef)

Prepare

a. As soon as all meat is removed from bones, saw or unjoint bones (never use cleaver) to 6 inch lengths to expose marrow. Place bones in 50# lard cans or in dish pans. Add extra scraps not suitable to be used in ground meat, and some fat.
   1. If lard tin is used, add about ¼ by volume of water to amount of bones.
   2. If dish pan is used, add about 1 inch of water to each pan.
b. Cook bones in retorts. Refer to general instructions. Process at 250°F., or 15# pressure for 60 minutes.
c. When pressure has dropped to zero, remove cans or pans of bones and meat from retort.
d. Drain off broth from bones and remove meat from bones.
e. Grind meat through hamburger plate.
f. Put meat and broth in separate containers and hold in exhaust box.
   1. Use broth for filling cans containing steaks, roasts, etc.
   2. Combine remaining broth and ground meat to make soup stock.

Prepare cans or glass jars

Use #2 or #2½ cans, or pint or quart glass jars with self-sealing closures. Wash cans or jars.

	Cans	Glass Jars
Fill	a. Fill cans with mixture of broth and ground meat. b. Add 1 tsp. salt to each #2½ can.	a. Fill jars to within ½ inch of top with mixture of ground meat and broth. b. Add 1 tsp. salt to each quart.
Exhaust	Bring center of can temperature to 170°F.	
Close	Place marked covers on cans and seal at once.	Wipe tops of jars with clean, damp cloth. Adjust lids.
Process	a. Process at 240°F. b. Processing time: #303 — 45 minutes #2 — 45 minutes #2½ — 50 minutes c. Remove cans from cooker as soon as pressure has returned to 0.	a. Process at 240°F. b. Processing time: Pints — 45 minutes Quarts — 50 minutes
Cool	Cool cans.	Cool jars.

Part III

Providing Instruction in Nutrition and Food Preservation

The purpose of Part III of this publication is to present examples of lesson plans and instructional materials for use by the instructor in teaching nutrition and food preservation. A variety of approaches is suggested in providing the instruction, including demonstrations, individual study of reference materials, practice sessions, discussion, and using various charts and diagrams. Since much of the instruction is on an individual basis, the instructor will need to be creative in selecting and using the appropriate techniques to meet individual needs.

The need for a systematic program of group instruction in meeting family food needs may exist in some communities. This need should be assessed by persons involved with school-community canneries. If a need is found to exist, some suggested units of instruction include the following:

Recognizing basic nutritional needs
Estimating family food needs
Planning a garden to meet family food needs
Selecting the location for the garden
Selecting varieties of vegetables
Preparing the seedbed
Fertilizing the garden
Planting the garden
Cultivating the garden
Controlling pests in the garden
Harvesting vegetables

How to Use the Sample Lesson Plans

The sample lesson plans are presented to assist instructors in planning for instruction in various areas of nutrition and food preservation. These are intended to serve as guides and are not designed to be used without local adaptation. The following explanations are given for the various parts of the sample plans.

Situation. The teacher will need to understand the local situation as appropriate to the unit, considering such things as student concern with the unit, prior instruction related to the unit, student background, importance of the unit in the community, and occupations for which a knowledge of the content is important.

Teacher Objectives. These are for the teacher's use only. They indicate the abilities the teacher expects the students to develop as a result of studying the unit.

Introduction. This section provides for introducing the unit, helping students recognize the problems as their own, giving the teacher an indication of what the students already know, stimulating the interest of students in the content, setting the stage for establishing student objectives and problems, and providing the students an opportunity to describe their experiences related to the content areas. These things may be accomplished through discussions, use of visual aids, use of field trips, or some other way. The introduction should supply the students with one or more reasons for studying the unit. A good introduction helps to increase student learning.

Group Objectives. These are the students' reasons for studying the unit and should be developed with the group. Students should express why they should be knowledgeable concerning the unit. The objectives listed in the outline are anticipated student responses and objectives are listed in somewhat general terms. Student objectives may be more specific according to their desires or needs. Developing the group objectives also should be motivating to the students.

Problems and Concerns of Students. This section reflects things the students should know about each problem area in order to accomplish their objectives. They should be drawn from the group. The teaching outline contains a list of problems students would be likely to suggest.

After the problems have been listed, the teacher should lead the students in a discussion of each problem taking the problems one at a time or in logical groups. He should find out what the students know, conduct supervised study on the items they do not know or use some other teaching technique for helping students secure needed information. These teaching techniques may include use of resource persons, lectures,

panel discussions, field trips, and/or visual aids. He should then lead the students in a discussion for the purpose of drawing conclusions appropriate to the local situation and to supervised agricultural occupation experience programs.

References. A suggested list of references is included for each problem area. Some of these are for teacher use and some for student use. This is not a complete list and the teacher should use all available references in studying this unit.

Visual Aids and Other Equipment. The outline contains a list of suggested visual aids and other equipment for use in studying each problem area.

Special Events and Activities. These are suggested special events and activities. Those used should be planned well in advance.

Application and Evaluation. Included are a few suggestions for occupational experience activities and testing. The teacher may wish to give examinations for the unit rather than for each problem area.

Content Summary. This section is for use only by the teacher. It is related to the "problems and concerns" sections and contains a summary of the material in the references. It is not intended to be all inclusive. The teacher will need to supplement this material when teaching the unit.

Sample Lesson Plan: Meeting Nutritional Needs

Enterprise: Family Living

Unit: Meeting Food Needs

Problem Area: Meeting Nutritional Needs

Situations (local):

Teacher Objectives:

Upon completion of this lesson plan, the students should be able to:

1. Explain the meaning of the terms "nutrient" and "nutrition."
2. Name the food nutrients and explain the functions and sources of each.
3. Explain the four food groups necessary in meeting dietary requirements.

Introduction:

The introduction should place stress on the importance of proper nutrition. Explain that poor nutrition can lead to health problems, including disease, retarded mental development, and lack of normal growth in children (if severe). Have students name various health conditions resulting from improper nutrition which they know about. Several examples are:

Anemia - Caused by a deficiency of iron which results in a shortage or red corpuscles or the corpuscles are deficient in hemoglobin. Anemia shows up as lack of color, shortness of breath, and palpitation of the heart.

Scurvy - Caused by a lack of vitamin C and is characterized by spongy gums and skin problems.

Rickets - Caused by a lack of vitamin D and is characterized by alteration in the bones due to defective deposit of calcium. This disease is found in small children and responds well to treatment with sunlight or vitamin D.

Goiter - Caused by a deficiency of iodine and is manifested by enlargement of the thyroid gland.

Kwashiorkor - Caused by a diet low in protein and most often seen in underdeveloped countries with low nutrition levels. Symptoms include changes in color and texture of the skin and swelling of the body. The intestines, liver, and pancreas may be damaged. Kwashiorkor may be fatal to children unless adequate protein is supplied.

Beriberi - Caused by a deficiency of vitamin B and is characterized by cracking and itching of skin, night blindness and lower resistance to disease.

Inarasmus - Caused by a diet low in calories.

The teacher should indicate that it is easy to meet nutritional needs if certain fundamental principles are kept in mind.

Group Objectives (develop with group or individually, depending on the nature of the instruction):

A suggested lead question is: "Why is it important to understand nutritional needs and how they are met?" The following objectives should evolve from a discussion of this question:

A. To explain the meaning of the term "nutrient."
B. To name the food nutrients and explain the functions of each in the human body.
C. To select foods which supply the essential nutrients.
D. To explain how the four food groups are used in meeting nutritional requirements.

Problems and Concerns:

A. What is meant by "nutrient?" "Nutrition?"
B. What are the classes of food nutrients?
C. What are the functions of food nutrients?
D. What are the food sources of the essential nutrients?
E. How are the four food groups used in meeting nutritional requirements?

References:

(See "Sources of Instructional Materials" for addresses to use in obtaining references.)

A. Bulletins and Pamphlets

1. "Nutrition: Why Is It Important," Campbell Soup Company, 1973.
2. "Nutrition News and Values," Stokely-Van Camp, Inc., (n.d.).
3. "Are Vegetables Doing Their Things for You?" Stokely-Van Camp, Inc., (n.d.).
4. "Daily Food Guide" (MF-50), Virginia Polytechnic Institute and State University, (n.d.).
5. "You and Your Food" (MF-ENEP-1), Virginia Polytechnic Institute and State University, 1970.
6. "Food Needs of Everybody" (publication 166), Virginia Polytechnic Institute and State University, 1973.
7. "Meal Planning Guide," Pet Incorp rated, 1969.
8. "Nutrition and Working Efficiency," Food and Agriculture Organization of the United Nations, 1962.
9. "Are Vegetables Doing Their Thing For You?" Stokely-Van Camp, Inc.

B. Books

1. Leudal H. Kotschevar and Margaret McWilliams. Understanding Food. New York: John Wiley and Sons, Inc., 1969.
2. Corinne H. Robinson. Fundamentals of Normal Nutrition. London: Collier-Macmillan Limited, 1968.
3. Marion L. Cronan and June Atwood. Foods in Homemaking. Peoria, Illinois: Chas. A. Bennett Co., Inc., 1972.
4. Alan Berg. The Nutrition Factor. Washington, D. C.: The Brookings Institute, 1973.

Visual Aids and Other Equipment:

A. Films

"Balance Your Diet for Health and Appearance," available for for rental from Paul L. Brand and Son, 234 W. Broad Street, Falls Church, VA 22046.

"Snacks Count Too," available for rental from University Film Rental Library, University of Illinois, Champaign, ILL. 61820.

"Balanced Way," available from Bureau of Teaching Materials, State Department of Education, Richmond, VA 23216.

"Nutritional Needs of Our Bodies," available from Bureau of Teaching Materials, State Department of Education, Richmond, VA 23216.

Special Events and Activities:

A. Develop a display of empty food containers by arranging in the four food groups. Use a placard or other label to identify the groups.

B. Review the labels on food containers to determine the ingredients, including nutrients in the food.

Application and Evaluation:

A. Have each student design a plan for providing the needed nutrients. The plan should be developed with menus for breakfast, lunch, and dinner.

B. Have each student keep a record of the food consumed for a period of one week. Determine if the food is meeting the nutritional needs, as specified in the "four food groups."

Content Summary:

What is meant by "nutrient?" "Nutrition?"

A nutrient is a food constituent, or group of foods of the same general composition, that nourishes and promotes life. Nutrients provide for the following life functions:

1. Promote growth.
2. Build and repair body tissue.
3. Regulate body processes.
4. Produce heat and energy.
5. Under specific conditions, develop the fetus.

Nutrition, in simple terms, refers to the food an individual eats and how it is used by the body. It is closely associated with good health, including how an individual looks and feels and mentally and physically performs. Good nutrition involves eating foods which provide the necessary nutrients for the conduct of life processes.

What are the classes of food nutrients?

There are six classes of food nutrients: protein, carbohydrates, fats, minerals, vitamins, and water.

What are the functions of food nutrients?

Each class of nutrients performs specific functions as related to life. These are summarized as follows:

Proteins	Build and renew body tissue. Promote growth of muscles, connective tissue, ligaments, etc. Provide energy. Regulate body processes. Promote health. Comprise cell structure.
Carbohydrates	Furnish energy. Furnish heat. Build body fat.
Fats	Furnish energy and heat. Build body fat. (Note: Fats perform almost the same functions as carbohydrates and are capable of providing 2¼ times as much energy and heat as carbohydrates.

Minerals	More than a dozen minerals are found in the body. The functions of some of the most important minerals are listed below.
Calcium	Builds bones and teeth, essential in blood clotting, and needed for healing wounds and broken bones. This is one of the most important minerals.
Phosphorus	Builds bones, teeth, and regulates body processes.
Iron	Builds red blood cells, body cells, and hemoglobin, which carries oxygen to all parts of the body.
Iodine	Prevents goiter and regulates use of energy in the body.
Copper	Necessary for utilization of iron.
Magnesium	Builds bones, helps transmit nerve impulses and aids in muscle contraction.
Potassium	Aids synthesis of protein, required for healthy nerves and muscles, and needed for enzyme reactions and fluid balance.
Sodium	Helps maintain fluid balance, balances acids in body, and aids in absorption of nutrients.
Zinc	Essential for normal growth and helps heal wounds.
Vitamins	A number of vitamins are important in regulating body functions and keeping it healthy. An adequate supply of vitamins is obtained when a balanced diet is followed. Several of the most important vitamins are listed and discussed below.
Vitamin A	Needed for growth and maintenance of healthy skin, helps resist infection, and aids good vision.
Vitamin D	Needed for healthy teeth and bones.
Vitamin K	Promotes normal blood clotting.
Vitamin E	Protects red blood cells and helps retard destruction of vitamin A.
Vitamin B_1* (Thiamine)	Helps body use carbohydrates and maintain nervous system.
Vitamin B_2* (Riboflavin)	Aids body in using protein, fats, and carbohydrates and keeps skin healthy, especially around mouth, nose, and eyes.
Vitamin B_{12}*	Aids in production of red blood cells in bone marrow, functioning of nervous tissue, and building the body.
Niacin*	Needed for healthy nervous system, skin, and normal digestion and aids in use of oxygen by body.
Vitamin C (Ascorbic Acid)	Needed for health of teeth, gums, and blood vessels and in resisting infection.

*These are a part of the Vitamin B complex, which includes more than a dozen vitamins, some of which are better known than others.

Water	Necessary for all chemical reactions in the body. It aids in digestion of food, transports nutrients, regulates body temperature, and is essential in the elimination of body wastes.

What are the food sources of the essential nutrients?

No single food item contains all of the needed nutrients. However, some food items do contain larger amounts of the more essential nutrients. A knowledge of which food items have the essential nutrients will be helpful to an individual in determining which to consume. Common sources of certain nutrients are presented below.

Nutrients	Sources
Proteins	Lean meat, poultry, fish, sea food, eggs, milk, and cheese are important sources. Other sources include beans, peas, breads, and cereals, and nuts, including peanuts and peanut butter.
Carbohydrates	Bread, rice, cereal, spaghetti, macaroni, noodles, dried fruit, grits, sugar, molasses, and honey are important sources.
Fats	Butter, vegetable oils, lard, nuts, margarine, meat, cheese, and egg yolks are sources of fat.
Minerals	
Calcium	Milk is an excellent source of calcium. Other sources include leafy greens, cheese, ice cream, broccoli, oysters, shrimp, salmon, clams, and cabbage.
Iron	Lean meat, including liver, kidneys, and heart; oysters; egg yolk; green vegetables; dried fruit; and whole-grain or enriched bread and cereals are good sources of iron.
Iodine	Seafood and foods grown near the seacoast are sources. The best source is iodized salt.
Copper	Meats (particularly liver), shellfish, nuts, raisins, cocoa, cereal, and chocolate are sources of copper.
Magnesium	Cereal, nuts, and meat are sources of magnesium. (A dietary deficiency of this mineral is unlikely.)
Potassium	Meat, fish, cereal, fruit and fruit juice, and vegetables are sources of potassium. (Well balanced diets usually supply ample potassium.)
Sodium	Salt, meat, fish, poultry, milk, and eggs are sources of this mineral.
Zinc	Green leafy vegetables, fruit, whole-grain foods, and lean meat are good sources of zinc.

Nutrients	Sources
Vitamins	
Vitamin A	Liver, kidney, egg yolk, dark green leafy vegetables, yellow-colored vegetables, tomatoes, fruits, butter, whole milk, cheese, and fish liver oils are sources of vitamin A.
Vitamin D	Fortified milk, egg yolk, liver, and fish are sources of vitamin D.
Vitamin K	Green leafy vegetables (spinach, kale, and cabbage), cauliflower, and pork liver.
Vitamin E	Green leafy vegetables, nuts, salad oils, shortening, and margarine are sources of vitamin E.
Vitamin B Complex	A variety of foods is required to meet requirements in the vitamin B complex. Some of the foods are meat, poultry, fish, milk, cheese, green leafy vegetables, dry beans and peas, peanuts, egg yolk, bread and cereal.
Vitamin C (Ascorbic Acid)	Citrus fruit and juices, cantaloupe, tomatoes, broccoli, raw green vegetables, potatoes, and strawberries.

How are the "four food groups" used in meeting nutritional requirements?

The "four food groups" is a simple guide to proper human nutrition. It is a means of translating technical knowledge of nutrition into a plan for everyday eating involving four groups of foods. Each group contains a variety of foods from which to choose. The four groups are: (1) vegetables and fruits group, (2) meat group, (3) milk group, and (4) bread and cereals group. It is important that one eat a variety of foods from each group <u>every day</u>. Each group is briefly discussed.

<u>Vegetables and Fruits Group</u>. Foods in this group supply a number of vitamins and minerals. Each person should eat four or more servings from this group every day. (A serving is ½ cup of vegetable or fruit or a portion as ordinarily served, such as a medium-size banana.) At least one serving each should consist of the following:

Citrus fruits, fruit juices, or vegetables which are high in vitamin C. (Examples include oranges, grapefruit, lemons, limes, strawberries, cantaloupe, tomatoes, and green and red pepper.)

Dark green and bright yellow fruits or vegetables. (Examples include apricots, carrots, okra, squash, mustard greens, turnip greens, spinach, collards, chard, sweet potatoes, snap beans, and brocolli.)

Potatoes and other fruits and vegetables. (Examples include apples, bananas, beets, cauliflower, celery onions, corn, dates, eggplant, peaches, pears, plums, prunes, rhubarb, rutabaga, cherries, and berries.)

<u>Meat Group</u>. Foods in the meat group supply protein, iron, vitamins, and other nutrients. Persons should eat two or more servings from this group each day. A serving is two to three ounces of lean, cooked meat,

fish and poultry, without bone. Examples of meats include beef, veal, lamb, pork, poultry, seafood, fish, and shellfish. It is possible to substitute dried beans, peas, eggs, cheese, peanuts, peanut butter, and nuts for a portion of the meat requirement. For example, one meat serving may be substituted with two eggs or one cup of dried beans or peas, or four tablespoons of peanut butter. Luncheon meats and other processed meat products may also be used in this group.

Milk Group. Foods in the milk group supply calcium, phosphorus, protein, and certain vitamins. These foods are also good sources of vitamins A and D, provided the milk product has been fortified. Requirements of persons for foods in this group vary and may be met with fluid whole milk, skim milk, evaporated milk, dry milk, ice cream, cheese, and other milk products. The recommended daily amounts in terms of 8-ounce cups of whole milk are:

children under age 9	2 to 3 cups
children 9 - 12	3 or more cups
teenage persons	4 or more cups
adults	2 or more cups

Bread and Cereals Group. Foods in this group, when enriched, restored or whole grain, furnish vitamins, minerals, carbohydrates, and small amounts of protein. Individuals should eat four or more servings from this group every day. A serving is one slice of bread, one ounce of ready-to-eat cereal, and 1/2 to 3/4 cups of cooked cereal, cornmeal, macaroni, rice, grits, noodles, or spaghetti.

Sample Lesson Plan: Planning for Meeting Food Needs

Enterprise: Family Living

Unit: Meeting Food Needs

Problem Area: Planning for Meeting Food Needs

Situation (local):

Teacher Objectives:

Upon completion of this lesson plan, the students should be able to:

1. Name the major sources of food and indicate the advantages and disadvantages of each.
2. Estimate the quantity of food required for their families.
3. Discuss the fundamentals of planning a garden.

Introduction:

The introduction will place stress on the importance of planning in order to maximize the benefits from food preservation. The produce that is preserved must be obtained in some way and it is to the families benefit to do this as economically as possible. In addition, the product to be preserved must be of good quality in order to insure a good food when served to the family.

Planning also involves some estimation of the quantity that will be required. Review the per capita annual consumption of various foods in the United States, as follows:

Annual Per Capita Consumption of Foods in the United States

	Pounds
Beef, veal, pork, lamb, and mutton	192
Chicken and turkey	50
Fresh fruits	81
Processed fruit and juices	51
Fresh vegetables	97
Canned or frozen vegetables	60
Dairy products (whole milk equivalent)	557
Potatoes and sweet potatoes	126

Source: "Background on U. S. Agriculture," Leaflet Number 491. Washington: U. S. Department of Agriculture, 1972.

It is well to note that the determination of the annual per capita consumption of food is based on averages. Individuals may vary considerably from a mathematical average, depending on income, cost and availability of food, personal preferences, and other reasons.

Stress that through proper planning a person with a garden can produce a considerable quantity of food. However, the supply is seasonal and through preservation the foods may be made available in other seasons. In addition, the costs of labor, garden seed, fertilizer, and other items, have increased resulting in more need for good planning of the garden. Persons who have limited garden space find planning useful in maximizing production from the space available. This is accomplished by wise succession-cropping and rotation.

Group Objectives (develop with group or individually, depending on the nature of the instruction):

A suggested lead question is: "What is involved in planning for the food needs of a family?" The following objectives can be developed through discussion of this question:

A. To select the best source of foods.
B. To estimate the quantity of food required by a family.
C. To plan an appropriate garden layout and schedule of crops.

Problems and Concerns:

A. What are the sources of produce for processing?
B. What are the advantages and disadvantages of the sources of produce?
C. What quantity of food is required for an individual? A family?
D. What should be considered in planning a garden?

References:

A. Bulletins and Pamphlets

"Basic Vegetable Gardening Guide," Northrup, King and Company, 1973.

"Vegetable Gardening," Virginia Polytechnic Institute and State University, 1955.

B. Books

G. W. Ware and J. P. McCollum. Producing Vegetable Crops. Danville, Illinois: The Interstate Printers and Publishers, Inc., 1968.

Vegetable Gardening. Menlo Park, California: Lane Book Company, 1974.

Special Events and Activities:

A. Have students compile a list of all the foods consumed by their family. Next, place a check (✓) by those which are grown in the family garden. Also, place an X by those which could be grown in the garden. (This procedure may show the need for better planning in use of the garden if the number of X's is greater than the number of checks (✓).)

B. If possible, arrange to visit one or more gardens. Discuss the arrangement of vegetable crops and the adequacy of the garden in meeting family food needs.

Application and Evaluation:

A. Have each student sketch the garden area currently being used. (Dimensions should be included.) Indicate the location of the different vegetable crops. Study the sketch to determine if the available space is being used to greatest advantage. Investigate relocating certain vegetables to other areas of the garden.

B. Have students estimate the amount of food required for their families for a year. Determine the amount which can be produced in the garden.

Content Summary:

What are the sources of produce for processing? What are the advantages and disadvantages of each?

Produce for home or cannery preservation may be purchased or grown in a home garden. In the past, many families have relied on a home garden to supply the vegetables which are preserved. Vegetables may be purchased from roadside stands, central markets, the grower on the farm, and supermarkets. The economic advantage of food preservation is lessened if vegetables are purchased for a greater cost than the cost of raising in the home garden. It is important to carefully analyze the advantages and disadvantages of all sources.

Advantages and Disadvantages of Different Sources of Vegetables for Preservation

Source	Advantages	Disadvantages
Home Garden	1. Good control over quality of vegetables to be processed. 2. May be more economical than other sources. 3. Gardening provides the exercise which some people need. 4. Can grow the varieties desired for preservation.	1. Must have adequate garden space available. 2. Must have time or labor to raise crops. 3. Must have needed tools and equipment.
Road Side Stands	1. Good quality vegetables can often be obtained if locally grown vegetables are sold. 2. May be more economical than supermarkets.	1. May be more expensive than home grown. 2. Control over quality is less than with home garden. 3. Control over variety available is less than with home garden.
Central Markets	1. During season, there may be a wide selection. 2. May be more economical than supermarkets. 3. May be of good quality if locally grown.	1. May be more expensive than home garden. 2. Control over quality is less than with home garden. 3. Control over varieties available is less than with home garden. 4. Supply may not be stable.
Farm (Buying on the farm)	1. Quality may be as good as home garden. 2. May be more economical than road side stands, central markets, and supermarkets, especially if "you pick your own."	1. May be more expensive than home garden. 2. Control over varieties available is less than with home garden. 3. Supply may be highly seasonal.

	3. May be available in larger quantities than with home garden. 4. With some farmers, it is possible to make request ahead of time.	
Supermarkets	1. Tend to have supply year around.	1. May be the most expensive source. 2. Quality may be lacking. 3. No control over varieties available. 4. Not usually available in large quantities.

What quantity of food is required for an individual? A family?

The amount of food required for an individual and family can be easily estimated. Such estimates should take into consideration nutritional needs, age, personal preferences, and kind of food to be available.

Family Food Needs and Goals for Meeting These Needs*

	Each Person Needs the Following Minimum Amounts for Good Nutrition	
	One Day	One Year
Milk	3-4 cups	90 gallons
Butter	1 ounce	26 pounds
Eggs	1 (at least 3-4 a week)	20-25 dozen
Meat	1 serving	100-125 pounds of lean meat, poultry, and fish
Potatoes	1-2 servings	5 bushels
Tomatoes, oranges, grapefruit, or raw cabbage	1-2 servings	3½-4 baskets of tomatoes
Vegetables, especially green and yellow colored vegetables	2 or more servings	
Fruit	1 or more	2½ bushels fresh fruit or 49 quarts canned.

*Bread and sugar are not listed.

What should be considered in planning a garden?

Planning a garden involves giving attention to a number of factors, such as personal preferences of family members for certain vegetables, amount of space available, and season in which vegetables are to be grown. In planning, it is a good idea to prepare a sketch of the space available. This plan should give consideration to the following factors:

1. Arrangement followed in the garden:
   a. Corn and other tall crops should be located so as not to shade low-growing crops.
   b. Perennials, such as asparagus, rhubarb, and strawberries should be located so as not to be damaged in plowing and harvesting other vegetables.
   c. Crops requiring longer times to maturity should be grouped together.
   d. Crops maturing early should be grouped together.

2. Direction of rows:
   a. A rectangular-shaped garden is to be preferred over a square-shaped garden.
   b. Rows should be run lengthwise on level ground.
   c. Rows should be run across the slope on land which is not level.

3. Row spacing:
   a. When hand-operated tools are used, rows may be as close as 12 inches apart for small-growing crops and 24 inches for larger-growing crops.
   b. When power-operated equipment is used, rows may need to be wider, depending on the type of equipment used.

4. Cropping methods:
   a. Succession or companion cropping makes for more efficient use of land. In succession cropping, two or three different crops may be planted in the same space. For example, at maturity, early-maturing crops are removed and another crop planted. With companion cropping two or more crops are grown on the same area at the same time. For example, lettuce may be grown in the row with cabbage or beans in the row with corn.
   b. Single cropping is inefficient when space is limited because it involves planting the garden only once, usually in the spring.

5. Size:
   a. The size of a garden depends on the number in a family, the nutritional needs of the family, method of cropping, and the availability of labor and equipment.
   b. It is a rule of thumb to allow 3,000 to 4,000 square feet of space for each person in a family, if space permits.

6. Drawing the plan:
   a. Plans should include kind of vegetable, variety, amount of space for each vegetable, planting date, and where each vegetable is to be located in a garden.
   b. If possible, plans should be drawn to scale and kept in a convenient location for use.

Sample Lesson Plan: Preserving Food

Enterprise: Family Living

Unit: Meeting Food Needs

Problem Area: Preserving Food

Situation (local):

Teacher Objectives:

Upon completion of this lesson plan, the students should be able to:
1. Name various methods used in preserving food.
2. Select the appropriate method for preserving various food products.
3. Properly preserve various food products.

Note: Much of the basic information for this lesson plan is presented in Parts I and II of this document.

Introduction:

The introduction will place stress on the "why" of food preservation, which is primarily to prevent food spoilage. Spoilage is often manifested by changes in the character of foods. These include changes in odor, flavor, and texture. Most spoilage is caused by yeasts, molds, and bacteria--all micro-organisms. ("Micro-organism" may be written as "microorganism" and refers to organisms which can normally be seen only with the aid of a microscope.)

Food preservation involves "treating" food products in some manner to reduce the number of micro-organisms or prevent the growth of such organisms. This treatment may involve a combination of procedures, such as heating food to a point where the micro-organisms are destroyed and sealing the food in a hermetic (airtight) container.

Stress that in preserving food it is important to follow the proper procedures. The food must be safe for consumption when it is used. Food poisoning may result from eating decayed food or food which has not been properly preserved. (The teacher may wish to have students relate examples they know of food poisoning.) One of the most severe food poisonings is botulism. This is a condition which develops when certain bacteria grow in food without air and form a powerful toxin. (It has been said that a spoonful of this toxin might kill a million persons.)

Group Objectives (develop with group or individually, depending on the nature of the instruction):

A suggested lead question is: "What is involved in preserving food?" Through discussion, the following objectives can be developed:

A. To name the methods of food preservation.
B. To select the appropriate method for preserving food products.
C. To properly preserve selected food products.

Problems and Concerns:

A. What are the methods of preserving food?
B. Which method of food preservation is appropriate for selected food products?
C. How are selected food products preserved?

References:

The primary references for this Lesson Plan are Parts I and II of this publication.

A. Bulletins and Pamphlets

"Home Canning of Fruits and Vegetables," Home and Garden Bulletin No. 8, U. S. Department of Agriculture, 1972.

"Home Canning of Meat and Poultry," Home and Garden Bulletin No. 106, U. S. Department of Agriculture, 1972.

"Home Freezing of Fruits and Vegetables," Home and Garden Bulletin No. 10, U. S. Department of Agriculture, 1972.

B. Books

Norman W. Desrosier. The Technology of Food Preservation. Westport, Connecticut: The AVI Publishing Company, Inc., 1970.

Anthony Lopez, A Complete Course in Canning. Baltimore: The Canning Trade, 1969.

Special Events and Activities:

A. Have students to observe the different ways foods are preserved, as found in a supermarket or at home.

B. Have students to observe containers (cans or jars) which show evidence of deterioration of the container or food product.

Application and Evaluation:

A. Have students select the appropriate method of preservation for the following foods:

beef steak
lima beans
squash
potatoes
corn (cream style)
tomato juice
onions
apples

B. Have students to can food products.

Content Summary:

What are the methods of preserving food?

The following methods are used in preserving food: (The first two are most commonly used.)

1. canning
2. freezing
3. fermenting
4. dehydrating (drying)
5. radiating
6. preserving with sugar
7. salting and smoking

Some food products may be stored without special preservation. The environment in which these are stored must be suitable if they are to be stored very long. Examples of foods which are stored include onions and potatoes.

Which method of food preservation is appropriate for selected food products?

The table below presents a summary of the recommended methods of preserving certain fruits and vegetables.

Product	Method of Preserving		
	Canning	Freezing	Storing
Vegetables:			
Asparagus	xxxx	xxxx	
Beans, lima	xxx	xxxx	
Beans, snap	xxxx	xxxx	
Beets	xxx	xx	
Broccoli		xxx	
Cabbage			xxx
Carrots	xxxx	xx	xxx
Corn, sweet	xxx	xxxx	
Kale	xxx	xx	
Onions			xxxx
Peas	xxx	xxxx	
Potatoes, Irish			xxxx
Potatoes, sweet	x		xxxx
Pumpkin	xx		xxx
Rhubarb	xxx	xxx	
Spinach	xxx	xxx	
Squash	x	x	xx
Tomatoes	xxxx		
Tomato juice	xxxx	xxx	

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	Canning	Freezing	Storing
Fruits:			
Apples	xx	xx	xxxx
Berries	xxxx	xxxx	
Cherries	xxxx	xxxx	
Grapes	xxxx	xxx	
Peaches	xxxx	xxxx	
Pears	xxx	x	xxx

* The more x's the more desirable the method of preserving the food.

How are selected food products preserved?

(This question refers only to canning. The content for this question is summarized in Parts I and II of this publication.)

Appendix

Sample Sources of Instructional Materials on Food Preservation

	Pamphlets	Books	Films
(The) AVI Publishing Company, Inc. Westport, Connecticut 06880		x	
Ball Corporation Muncie, Indiana 47302		x	
Bureau of Teaching Materials State Department of Education Richmond, Virginia 23216			x
Campbell Soup Company Home Economics Department Campbell Place Camden, New Jersey 08101	x		
(The) Canning Trade, Inc. 2619 Maryland Avenue Baltimore, Maryland 21218		x	
Chas. A. Bennett Co., Inc. 809 West Detweiller Drive Peoria, Illinois 61614		x	
Food and Agriculture Organization of the United Nations Unipub, Inc. 650 1st Avenue Box 433 New York, New York 10016	x		
Kerr Glass Mfg. Corporation Consumer Products Division Box 97 Sand Springs, Oklahoma 74063	x		
Northrup, King and Company 1500 Jackson Street, N. E. Minneapolis, Minnesota 55413	x		
Pet Incorporated Home Economics Pet Plaza 400 South Fourth Street Saint Louis, Missouri 63166	x		

	Pamphlets	Books	Films
Stokely-Van Camp, Inc. Home Economics Department 941 North Meridian Street Indianapolis, Indiana 46206	x		
U. S. Department of Agriculture Office of Information Washington, D. C. 20250	x		
Virginia Polytechnic Institute and State University Cooperative Extension Service Distribution Center Blacksburg, Virginia 24061	x		

Bibliography

The Bibliography contains excellent sources of additional information for persons involved with school-community canneries.)

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Ball Blue Book. Muncie, Indiana: Ball Corporation, 1974.

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Basic Vegetable Gardening Guide. Minneapolis: Northrup, King and Company, 1973.

Bert, Alan. The Nutrition Factor. Washington: The Brookings Institute, 1973.

Borgstrom, Georg. Principles of Food Science, Volume I and II. New York: The Macmillan Company, 1968.

Carroll, Lula Mae. Canning Fruits and Vegetables in School-Community Food Preservation Laboratories. Baton Rouge: State Department of Education of Louisiana, 1952.

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Food Needs of Everybody, Publication 166. Blacksburg, Virginia Polytechnic Institute and State University, Extension Division, 1973.

Home Canning of Fruits and Vegetables, Home and Garden Bulletin No. 8. Washington: U. S. Department of Agriculture, 1972.

Home Canning of Meat and Poultry, Home and Garden Bulletin No. 106. Washington: U. S. Department of Agriculture, 1972.

Home Freezing of Fruits and Vegetables, Home and Garden Bulletin No. 10. Washington: U. S. Department of Agriculture, 1971.

Home Freezing of Poultry, Home and Garden Bulletin No. 70. Washington: U. S. Department of Agriculture, 1970.

Kerr Home Canning and Freezing Book. Sand Springs, Oklahoma: Kerr Glass Manufacturing Corporation, n. d.

Kotschevar, Leudal H. and Margaret McWilliams, Understanding Food. New York: John Wiley and Sons, Inc., 1969.

Lopez, Anthony. A Complete Course in Canning. Baltimore: The Canning Trade, 1969.

Nutrition: Why Is It Important? Camden, New Jersey: Campbell Soup Company, 1973.

Presto Cooker-Canner: Instructions, Recipes, and Time Tables. Eau Claire, Wisconsin: National Presto Industries, Inc., 1974.

Processes for Low-Acid Foods in Metal Containers, Washington: National Canners Association, 1966.

Robinson, Corinne H. Fundamentals of Normal Nutrition. New York: The Macmillan Company, 1968.

Slaughtering, Cutting, and Processing Pork on the Farm, Farmer's Bulletin No. 2138. Washington: U. S. Department of Agriculture, 1973.

Some Aspects of Food Preservation. Muncie, Indiana: Ball Corporation, n. d.

(The) Top Double Seam for Round Cans. New York: American Can Company, 1957.

Top Double Seaming Manual. New York: Continental Can Company, 1966.

Vegetable Gardening. Menlo Park, California: Lane Books, 1974.

Wolf, Isabel. Home Canning Fruits and Vegetables, Extension Folder 100. St. Paul: University of Minnesota, Extension Service, 1974.